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ELEMENTS

OF THE

PHILOSOPHY OF THE HUMAN MIND.

BY

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After an interval of more than twenty years, I venture to present to the public a Second Volume on the Philosophy of the Human Mind.

When the preceding Part was sent to the press, I expected that a few short chapters would comprehend all that I had further to offer concerning the Intellectual Powers; and that I should be able to employ the greater part of this Volume in examining those principles of our constitution, which are immediately connected with the Theory of Morals. On proceeding, however, to attempt an analysis of Reason, in the more strict acceptation of that term, I found so many doubts crowding on me with respect to the logical doctrines then generally received, that I was forced to abandon the comparatively limited plan according to which I had originally intended to treat of the Understanding, and, in the mean time, to suspend the continuation of my work, till a more unbroken leisure should allow me to resume it with a less divided attention.

Of the accidents which have since occurred to retard my progress, it is unnecessary to take any notice here. I allude to them, merely as an apology for those defects of method, which are the natural, and perhaps the unavoidable consequences of the frequent interruptions by which the train of my thoughts has been diverted to other pursuits. Such of my readers as are able to judge how very large a proportion of my materials has been the fruit of my own meditations; and who are aware of the fugitive nature of our reasonings concerning phenomena so far removed from the perceptions of Sense, will easily conceive the difficulty I must occasionally have experienced, in deciphering the short and slight hints on these topics, which I had committed to writing at remote periods of my life; and still more, in recovering the thread which had at first connected them together in the order of my researches.

I have repeatedly had occasion to regret the tendency of this intermitted and irregular mode of composition, to deprive my speculations of those advantages, in point of continuity, which, to the utmost of my power, I have endeavoured to give them. But I would willingly indulge the hope, that this is a blemish more likely to meet the eye of the author than of the reader; and I am confident, that the critic who shall honour me with a sufficient degree of attention, to detect it where it may occur, will not be inclined to treat it with an undue severity.

A Third Volume (of which the chief materials are already prepared) will comprehend all that I mean to publish under the title of the Philosophy of the Human Mind. The principal subjects allotted for it are Language; Imitation; the Varieties of Intellectual Character; and the Faculties by which Man is distinguished from the lower animals. The two first of these articles belong, in strict propriety, to this second part of my work; but the size of the volume has prevented me from entering on the consideration of them at present.

The circumstances which have so long delayed the publication of these volumes on the Intellectual Powers, have not operated, in an equal degree, to prevent the prosecution of my inquiries into those principles of Human Nature, to which my attention was, for many years, statedly and forcibly called by my official duty. Much, indeed, still remains to be done in maturing, digesting, and arranging many of the doctrines which I was accustomed to introduce into my lectures; but if I shall be blessed, for a few years longer, with a moderate share of health and of mental vigour, I do not altogether despair of yet contributing something, *in the form of Essays*, to fill up the outline which the sanguine imagination of youth encouraged me to conceive, before

I had duly measured the magnitude of my undertaking with the time or with the abilities which I could devote to the execution.

The volume which I now publish is more particularly intended for the use of Academical Students; and is offered to them as a guide or assistant, at that important stage of their progress, when the usual course of discipline being completed, an inquisitive mind is naturally led to review its past attainments, and to form plans for its future improvement. In the prosecution of this design, I have not aimed at the establishment of new theories; far less have I aspired to the invention of any new *organ* for the discovery of truth. My principal object is to aid my readers in unlearning the scholastic errors which, in a greater or less degree, still maintain their ground in our most celebrated seats of learning; and by subjecting to *free*, but I trust, not *sceptical* discussion, the more enlightened though discordant systems of modern Logicians, to accustom the understanding to the unfettered exercise of its native capacities. That several of the views opened in the following pages appear to myself original, and of some importance, I will not deny; but the reception these may meet with, I shall regard as a matter of comparative indifference, if my labours be found useful in training the mind to those habits of reflection on its own operations, which may enable it to superadd to the instructions of the schools, that higher education which no schools can bestow.

Kinneil-House, 22*d November*, 1813.

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ELEMENTS

OF THE

PHILOSOPHY OF THE HUMAN MIND.

PART SECOND.

OF REASON, OR THE UNDERSTANDING PROPERLY SO CALLED; AND THE VARIOUS FACULTIES AND OPERATIONS MORE IMMEDIATELY CONNECTED WITH IT.

PRELIMINARY OBSERVATIONS ON THE VAGUENESS AND AMBIGUITY OF THE COMMON PHILOSOPHICAL LANGUAGE RELATIVE TO THIS PART OF OUR CONSTITUTION.—REASON AND REASONING,—UNDERSTANDING,—INTELLECT,—JUDGMENT, &c.

THE power of Reason, of which I am now to treat, is unquestionably the most important by far, of those which are comprehended under the general title of Intellectual. It is on the right use of this power, that our success in the pursuit both of knowledge and of happiness depends; and it is by the exclusive possession of it that Man is distinguished, in the most essential respects, from the lower animals. It is, indeed, from their subserviency to its operations, that the other faculties, which have been hitherto under our consideration, derive their chief value.

In proportion to the peculiar importance of this subject are its extent and its difficulty;—both of them such as to lay me under a necessity, now that I am to enter on the discussion, to contract, in various instances, those designs in which I was accustomed to indulge myself, when I looked forward to it from a distance. The execution of them at present, even if I were more competent to the task, appears to me, on a closer examination, to be altogether incompatible with the comprehensiveness of the general plan which was sketched out in the advertisement prefixed to the former volume; and to the accomplishment of which I am anxious, in the first instance, to direct my efforts. If that undertaking should ever be completed, I may perhaps be able afterwards to offer additional illustrations of certain articles, which the limits of this part of my work prevent me from considering with the attention which they deserve. I should wish, in particular, to contribute something more than I can here introduce, towards a rational and practical system of Logic, adapted to the present state of human knowledge, and to the real business of human life.

"What subject (says Burke) does not branch out to infinity! It is the nature of our particular scheme, and the single point of view in which we consider it, which ought to put a stop to our researches."* How forcibly does the remark apply to all those speculations which relate to the principles of the Human Mind!

I have frequently had occasion, in the course of the foregoing disquisitions, to regret the obscurity in which this department of philosophy is involved, by the vagueness and ambiguity of words; and I have mentioned, at the same time, my unwillingness to attempt verbal innovations, wherever I could possibly avoid them, without essential injury to my argument. The rule which I have adopted in my own practice is, to give to every faculty and operation of the mind its own appropriate name; following, in the selection of this name, the *prevalent* use of our best writers; and endeavouring afterwards, as far as I have been able, to employ each word *exclusively*, in that acceptation in which it has hitherto been used *most generally*. In the judgments which I have formed on points of this sort, it is more than probable that I may sometimes have been mistaken: but the mistake is of little consequence, if I myself have invariably annexed the same meaning to the same phrase;—an accuracy which I am not so presumptuous as to imagine that I have uniformly attained, but which I am conscious of having, at least, uniformly attempted. How far I have succeeded, they alone who have followed my reasonings with a very critical attention are qualified to determine; for it is not by the statement of formal definitions, but by the habitual use of precise and appropriate language, that I have endeavoured to fix in my reader's mind the exact import of my expressions.

---

* Conclusion of the Inquiry into the Sublime and the Beautiful.

In appropriating, however, particular words to particular ideas, I do not mean to censure the practice of those who may have understood them in a sense different from that which I annex to them; but I found that, without such an appropriation, I could not explain my notions respecting the human mind, with any tolerable degree of distinctness. This scrupulous appropriation of terms, if it can be called an *innovation*, is the only one which I have attempted to introduce; for in no instance have I presumed to annex a philosophical meaning to a technical word belonging to this branch of science, without having previously shown, that it has been used in the same sense by good writers, in some passages of their works. After doing this, I hope I shall not be accused of affectation, when I decline to use it in any of the other acceptations in which, from carelessness or from want of precision, they may have been led occasionally to employ it.

Some remarkable instances of vagueness and ambiguity in the employment of words, occur in that branch of my subject of which I am now to treat. The word *Reason* itself is far from being precise in its meaning. In common and popular discourse, it denotes that power by which we distinguish truth from falsehood, and right from wrong; and by which we are enabled to combine means for the attainment of particular ends. Whether these different capacities are, with strict logical propriety, referred to the same power, is a question which I shall examine in another part of my work; but that they are all included in the idea which is generally annexed to the word *reason*, there can be no doubt; and the case, so far as I know, is the same with the corresponding term in all languages whatever. The fact probably is, that this word was first employed to comprehend the principles, whatever they are, by which man is distinguished from the brutes; and afterwards came to be somewhat limited in its meaning, by the more obvious conclusions concerning the nature of that distinction, which present themselves to the common sense of mankind. It is in this enlarged meaning that it is opposed to *instinct* by Pope:

> "And Reason raise o'er Instinct as you can;
> In this 'tis God directs, in that 'tis Man."

It was thus, too, that Milton plainly understood the term, when he remarked, that smiles imply the exercise of reason;

"........Smiles from Reason flow,
To brutes denied:"............

And still more explicitly in these noble lines:

"There wanted yet the master-work, the end
Of all yet done; a creature, who not prone
And brute as other creatures, but endued
With sanctity of REASON, might erect
His stature, and upright with front serene
Govern the rest, self-knowing; and from thence,
Magnanimous, to correspond with heaven;
But, grateful to acknowledge whence his good
Descends, thither with heart, and voice, and eyes
Directed in devotion, to adore
And worship God Supreme, who made him chief
Of all his works."

Among the various characteristics of humanity, the power of devising means to accomplish ends, together with the power of distinguishing truth from falsehood, and right from wrong, are obviously the most conspicuous and important; and accordingly it is to these that the word *reason*, even in its most comprehensive acceptation, is now exclusively restricted.*

---

* This, I think, is the meaning which most naturally presents itself to common readers, when the word *reason* occurs in authors not affecting to aim at any nice logical distinctions; and it is certainly the meaning which must be annexed to it, in some of the most serious and important arguments in which it has ever been employed. In the following passage, for example, where Mr. Locke contrasts the light of Reason with that of Revelation, he plainly proceeds on the supposition, that it is competent to appeal to the former, as affording a standard of right and wrong, not less than of speculative truth and falsehood; nor can there be a doubt that, when he speaks of *truth* as the object of natural reason, it was principally, if not wholly, *moral* truth, which he had in his view:—"Reason is natural revelation, whereby the eternal Father of Light, and fountain of all knowledge, communicates to mankind that portion of truth which he has laid within the reach of their natural faculties. Re-

By some philosophers, the meaning of the word has been, of late, restricted still farther; to the power by which we distinguish truth from falsehood, and combine means for the accomplishment of our purposes:—the capacity of distinguishing right from wrong, being referred to a separate principle or faculty, to which different names have been assigned in different ethical theories. The following passage from Mr. Hume contains one of the most explicit statements of this limitation which I can recollect: "Thus, the distinct boundaries and offices of reason and of taste are easily ascertained. The former conveys the knowledge of truth and falsehood; the latter gives the sentiment of beauty and deformity,—vice and virtue. Reason, being cool and disengaged, is no motive to action, and directs only the impulse received from appetite or inclination, by showing us the means of attaining happiness or avoiding misery. Taste, as it gives pleasure or pain, and thereby constitutes happiness or misery, becomes a motive

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velation is natural reason, enlarged by a new set of discoveries, communicated by God immediately, which reason vouches the truth of, by the testimony and proofs it gives that they come from God. So that he who takes away reason to make way for revelation, puts out the light of both, and does much the same, as if he would persuade a man to put out his eyes, the better to receive the remote light of an invisible star by a telescope."—*Locke's Essay*, B. iv. c. 19.

A passage still more explicit for my present purpose, occurs in the pleasing and philosophical conjectures of Huyghens, concerning the planetary worlds. "Positis vero ejusmodi planetarum incolis ratione utentibus, quæri adhuc potest, anne idem illic, atque apud nos, sit hoc quod *rationem* vocamus. Quod quidem ita esse omnino dicendum videtur, neque aliter fieri posse: sive usum rationis in his consideremus quæ ad mores et æquitatem pertinent, sive in iis quæ spectant ad principia et fundamenta scientiarum. Etenim ratio apud nos est, quæ sensum justitiæ, honesti, laudis, clementiæ, gratitudinis ingenerat, mala ac bona in universum discernere docet: quæque ad hæc animum disciplinæ, multorumque inventorum capacem reddit," &c. &c.—*Hugenii Opera Varia*, Vol. II. p. 663. Ludg. Batav. 1724.

to action, and is the first spring or impulse to desire and volition."[*]

On the justness of this statement of Mr. Hume, I have no remarks to offer here; as my sole object in quoting it was to illustrate the different meanings annexed to the word *reason* by different writers. It will appear afterwards, that, in consequence of this circumstance, some controversies, which have been keenly agitated about the principles of morals, resolve entirely into verbal disputes; or, at most, into questions of arrangement and classification, of little comparative moment to the points at issue.[†]

Another ambiguity in the word *reason*, it is of still greater consequence to point out at present; an ambiguity which leads us to confound our rational powers in general, with that particular branch of them, known among logicians by the name of the *Discursive faculty*. The affinity between the words *reason* and *reasoning* sufficiently accounts for this inaccuracy in common and popular language; although it cannot fail to appear obvious, on the slightest reflection, that, in strict propriety, *reasoning* only expresses *one* of the various functions or operations of *reason*; and that an extraordinary capacity for the former by no means affords a test by which the other constituent elements of the latter may be measured.* Nor is it to common and popular language that this inaccuracy is confined. It has extended itself to the systems of some of our most acute philosophers, and has, in various instances, produced an apparent diversity of opinion where there was little or none in reality.

---

[*] Essays and Treatises, &c. Appendix, concerning Moral Sentiment.

[†] In confirmation of this remark, I shall only quote at present a few sentences from an excellent discourse, by Dr. Adams of Oxford, on the nature and obligations of virtue. "Nothing can bring us under an obligation to do what appears to our moral judgment *wrong*. It may be supposed our interest to do this; but it cannot be supposed our duty.——Power may compel, interest may bribe, pleasure may persuade; but REASON only can oblige. This is the only authority which rational beings can own, and to which they owe obedience."

It must appear perfectly obvious to every reader, that the apparent difference of opinion between this writer and Mr. Hume, turns chiefly on the different degrees of latitude with which they have used the word *reason*. Of the two, there cannot be a doubt that Mr. Adams has adhered by far the most faithfully, not only to its acceptation in the works of our best English authors, but to the acceptation of the corresponding term in the ancient languages. "Est quidem vera lex, recta ratio——quæ vocet ad officium, jubendo; vetando, a fraude deterreat," &c. &c.

"No hypothesis (says Dr. Campbell) hitherto invented, hath shown that, by means of the discursive faculty, without the aid of any other mental power, we could ever obtain a notion of either the beautiful or the good."† The remark is undoubtedly true, and may be applied to all those systems which ascribe to reason the origin of our moral ideas, if the expressions *reason* and *discursive faculty* be used as synonymous. But it was assuredly not in this restricted acceptation, that the word *reason* was understood by those ethical writers, at whose doctrines this criticism seems to have been pointed by the ingenious author. That the discursive faculty alone is sufficient to account for the origin of our moral ideas, I do not know that any theorist, ancient or modern, has yet ventured to assert.

Various other philosophical disputes might be mentioned, which would be at once brought to a conclusion, if this distinction between reason and the power of reasoning were steadily kept in view.[*]

---

* "The two most different things in the world (says Locke) are, a logical chicaner, and a man of reason."—*Conduct of the Understanding*, § 3.

† Philosophy of Rhetoric, Vol. I. p. 204.

---

[*] It is curious, that Dr. Johnson has assigned to this very limited, and (according to present usage) very doubtful interpretation of the word *reason*, the *first* place in his enumeration of its various meanings, as if he had thought it the sense in which it is most properly and correctly employed. "Reason (he tells us) is the power by which man "deduces one proposition from another, or proceeds from premises to consequences." The authority which he has quoted for this definition is still more curious, being manifestly altogether inapplicable to his purpose. "Reason is the director of man's will, discovering in action what is good; for the laws of well-doing are the dictates of right reason." *Hooker.*

In the *sixth* article of the same enumeration, he states, as a distinct meaning of the same word, *ratiocination, discursive power*. What possible difference could he conceive between this signification and that above quoted? The authority, however, which he produces for this last explanation, is worth transcribing. It is a passage from Sir John Davis, where that fanciful writer states a distinction between reason and understanding; to which he seems to have been led by a conceit founded on their respective etymologies.

"When she rates things, and moves from ground to ground,
The name of Reason she obtains by this;
But when by Reason she the truth hath found,
And standeth fixt, she Understanding is."

The adjective *reasonable*, as employed in our language, is not liable to the same ambiguity with the substantive from which it is derived. It denotes a character in which *reason* (taking that word in its largest acceptation) possesses a decided ascendant over the temper and the passions; and implies no particular propensity to a display of the discursive power, if indeed it does not exclude the idea of such a propensity. In the following stanza, Pope certainly had no view to the logical talents of the lady whom he celebrates:

"I know a thing that's most uncommon,
(Envy be silent and attend)
I know a *reasonable* woman,
Handsome and witty, yet a friend."

Of this *reasonable woman*, we may venture to conjecture, with some confidence, that she did not belong to the class of those *femmes raisonneuses*, so happily described by Moliere:

"Raisonner est l'emploi de toute ma maison
Et le raisonnement en bannit la raison."

In the use which I make of the word *reason*, in the title of the following disquisitions, I employ it in a manner to which no philosopher can object—to denote merely the power by which we distinguish truth from falsehood, and combine means for the attainment of our ends: omitting for the present all consideration of that function which many have ascribed to it, of distinguishing right from wrong: without, however, presuming to call in question the accuracy of those by whom the term has been thus explained. Under the title of *Reason*, I shall consider also whatever faculties and operations appear to be more immediately and essentially connected with the discovery of *truth*, or the attainment of the objects of our pursuit, more particularly the Power of Reasoning or Deduction; but distinguishing, as carefully as I can, our capacity of carrying on this logical process, from those more comprehensive powers which Reason is understood to imply.

The latitude with which this word has been so universally used, seemed to recommend it as a convenient one for a *general title*, of which the object is rather comprehension than precision. In the discussion of particular questions, I shall avoid the employment of it as far as I am able; and shall endeavour to select other modes of speaking, more exclusively significant of the ideas which I wish to convey.*

---

* Mr. Locke too has prefixed the same title, *Of Reason*, to the 17th chapter of his Fourth Book, using the word in a sense nearly coinciding with that very extensive one which I wish my readers to annex to it here.

After observing, that by reason he means "that faculty whereby man is supposed to be distinguished from brutes, and wherein it is evident he much surpasses them;" he adds, that "we may in reason consider these four degrees:— the first and highest is the discovering and finding out of proofs; the

Another instance of the vagueness and indistinctness of the common language of logicians, in treating of this part of the Philosophy of the Human Mind, occurs in the word *Understanding*. In its popular sense it seems to be very nearly synonymous with *reason*, when that word is used most comprehensively; and is seldom or never applied to any of our faculties, but such as are immediately subservient to the investigation of truth, or to the regulation of our conduct. In this sense, it is so far from being understood to comprehend the powers of Imagination, Fancy, and Wit, that it is often stated in direct opposition to them: as in the common maxim, that a sound understand-

second, the regular and methodical disposition of them, and laying them in a clear and fit order, to make their connexion and force be plainly and easily perceived; the third is the perceiving their connexion; and the fourth is making a right conclusion."

Dr. Reid's authority for the use of this word is equally explicit: "The power of reasoning is very nearly allied to that of judging. We include both under the name of *reason*."—*Intellect. Powers*, p. 671. 4to edit.

Another authority to the same purpose, is furnished by Milton:

> .... " Whence the soul
> Reason receives; and Reason is HER BEING ....
> .... *Discursive* or intuitive."
>
> *Par. Lost*, B. V. l. 488.

[I presume that Milton, who was a logician as well as a poet, means by the words *her being*, her *essential* or characteristical endowment.]

To these quotations I shall only add a sentence from a very judicious French writer; which I am tempted to introduce here, less on account of the sanction which it gives to my own phraseology, than of the importance of the truth which it conveys.

" Reason is commonly employed as an instrument to acquire the sciences; whereas, on the contrary, the sciences ought to be made use of as an instrument to give reason its perfection."—*L'Art de Penser*, translated by Ozell, p. 2. London, 1717.

ing and a warm imagination are seldom united in the same person. But philosophers, without rejecting this use of the word, very generally employ it, with far greater latitude, to comprehend all the powers which I have enumerated under the title of intellectual; referring to it Imagination, Memory, and Perception, as well as the faculties to which it is appropriated in popular discourse, and which it seems indeed most properly to denote. It is in this manner that it is used by Mr. Locke in his celebrated Essay; and by all the logicians who follow the common division of our mental powers into those of the Understanding and those of the Will.

In mentioning this ambiguity, I do not mean to cavil at the phraseology of the writers from whom it has derived its origin, but only to point it out as a circumstance which may deserve attention in some of our future disquisitions. The division of our powers which has led to so extraordinary an extension of the usual meaning of language, has an obvious foundation in the constitution of our nature, and furnishes an arrangement which seems indispensable for an accurate examination of the subject: nor was it unnatural to bestow on those faculties, which are all subservient in one way or another to the right exercise of the Understanding, the name of that power, from their relation to which their chief value arises.

As the word *understanding*, however, is one of those which occur very frequently in philosophical arguments, it may be of some use to disengage it from the ambiguity just remarked; and it is on this account that I have followed the example of some late writers, in distinguishing the two classes of powers which were formerly referred to the

Understanding and to the Will, by calling the former *intellectual*, and the latter *active*. The terms *cognitive* and *motive* were long ago proposed for the same purpose by Hobbes ; but they never appear to have come into general use, and are indeed liable to obvious objections.

It has probably been owing to the very comprehensive meaning annexed in philosophical treatises to the word *Understanding*, that the use of it has so frequently been supplied of late by *Intellect*. The two words, as they are commonly employed, seem to be very nearly, if not exactly, synonymous : and the latter possesses the advantage of being quite unequivocal, having never acquired the latitude of application of which the former admits. The adjective *intellectual*, indeed, has had its meaning extended as far as the substantive *understanding ;* but, as it can be easily dispensed with in our particular arguments, it may, without inconvenience, be adopted as a distinctive epithet, where nothing is aimed at but to mark, in simple and concise language, a very general and obvious classification. The word *intellect* can be of no essential use whatever, if the ambiguity in the signification of the good old English word *understanding* be avoided ; and as to *intellection*, which a late very acute writer* has attempted to introduce, I can see no advantage attending it, which at all compensates for the addition of a new and uncouth term to a phraseology which, even in its most simple and unaffected form, is so apt to revolt the generality of readers.

The only other indefinite word which I shall take notice of in these introductory remarks, is *judgment ;* and, in doing so, I shall confine myself to such of its ambiguities as are more peculiarly connected with our present subject. In some cases, its meaning seems to approach to that of *understanding*; as in the nearly synonymous phrases, *a sound understanding*, and *a sound judgment*. If there be any difference between these two modes of expression, it appears to me to consist chiefly in this, that the former implies a greater degree of positive ability than the latter; which indicates rather an exemption from those biasses which lead the mind astray, than the possession of any uncommon reach of capacity. To *understanding* we apply the epithets strong, vigorous, comprehensive, profound: To *judgment*, those of correct, cool, unprejudiced, impartial, solid. It was in this sense that the word seems to have been understood by Pope in the following couplet:

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* Dr. Campbell. See his Philosophy of Rhetoric, Vol. I. p. 103. 1st edit.

> "'Tis with our judgments as our watches; none
> Go just alike, yet each believes his own."

For this meaning of the word, its primitive and literal application to the judicial decision of a tribunal accounts sufficiently.

Agreeably to the same fundamental idea, the name of *judgment* is given, with peculiar propriety, to those acquired powers of discernment which characterize a skilful critic in the fine arts: powers which depend, in a very great degree, on a temper of mind free from the undue influence of authority and of casual associations. The power of Taste itself is frequently denoted by the appellation of *judgment*: and a person who possesses a more than ordinary share of it is said to be *a judge* in those matters which fall under its cognizance.

The meaning annexed to the word by logical writers is considerably different from this; denoting one of the simplest acts or operations of which we are conscious, in the exercise of our rational powers. In this acceptation, it does not admit of definition, any more than *sensation*, *will*, or *belief*. All that can be done, in such cases, is to describe the occasions on which the operation takes place, so as to direct the attention of others to their own thoughts. With this view, it may be observed, in the present instance, that when we give our assent to a mathematical axiom; or when, after perusing the demonstration of a theorem, we assent to the conclusion; or, in general, when we pronounce concerning the truth or falsity of any proposition, or the probability or improbability of any event, the power by which we are enabled to perceive what is true or false, probable or improbable, is called by logicians the faculty of *judgment*. The same word, too, is frequently used to express the particular acts of this power, as when the decision of the understanding on any question is called a judgment of the mind.

In treatises of logic, *judgment* is commonly defined to be an act of the mind, by which one thing is affirmed or denied of another; a definition which, though not unexceptionable, is perhaps less so than most that have been given on similar occasions. Its defect (as Dr. Reid has remarked) consists in this,—that although it be by affirmation or denial that we express our judgments to others, yet judgment is a solitary act of the mind, to which this affirmation or denial is not essential; and therefore, if the definition be admitted, it must be understood of mental affirmation or denial only; in which case, we do no more than substitute, instead of the thing defined, another mode of speaking perfectly synonymous. The definition has, however, notwithstanding this imperfection, the merit of a conciseness and perspicuity, not often to be found in the attempts of logicians to explain our intellectual operations.

Mr. Locke seems disposed to restrict the word *judgment* to that faculty which pronounces concerning the verisimilitude of doubtful propositions; employing the word *knowledge* to express the faculty which perceives the truth of propositions, either intuitively or demonstratively certain. "The faculty which God has given man to supply the want of clear and certain *knowledge* in cases where that cannot be had, is *judgment;* whereby the mind takes its ideas to agree or disagree; or, which is the same thing, any proposition to be true or false, without perceiving a demonstrative evidence in the proofs.

Thus, the mind has two faculties, conversant about truth and falsehood.

"First, *knowledge*, whereby it certainly perceives, and is undoubtedly satisfied of the agreement or disagreement of any ideas.

"Secondly, *judgment*, which is the putting ideas together, or separating them from one another in the mind, when their agreement or disagreement is not perceived, but presumed to be so; which is, as the word imports, taken to be so, before it certainly appears. And if it so unites, or separates them, as in reality things are, it is *right judgment*."*

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* Essay on the Human Understanding, Book iv. Chap. 14.

For this limitation in the definition of *judgment*, some pretence is afforded by the literal signification of the word, when applied to the decision of a tribunal; and also, by its metaphorical application to the decisions of the mind, on those critical questions which fall under the province of Taste. But, considered as a technical or scientific term of logic, the practice of our purest and most correct writers, sufficiently sanctions the more enlarged sense in which I have explained it; and, if I do not much deceive myself, this use of it will be found more favourable to philosophical distinctness than Mr. Locke's language, which leads to an unnecessary multiplication of our intellectual powers. What good reason can be given for assigning one name to the faculty which perceives truths that are *certain*, and another name to the faculty which perceives truths that are *probable?* Would it not be equally proper to distinguish, by different names, the power by which we perceive one proposition to be *true*, and another to be *false?*

As to *knowledge*, I do not think that it can, with propriety, be contrasted with *judgment;* nor do I apprehend that it is at all agreeable, either to common use or to philosophical accuracy, to speak of knowledge as a *faculty*. To me it seems rather to denote the *possession* of those truths about which our faculties have been previously employed, than any separate power of the understanding by which truth is perceived.*

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* In attempting thus to fix the logical import of various words in our language, which are apt to be confounded, in popular speech, with *reason*, and also with *reasoning*, some of my readers may be surprised, that I have said nothing about the word *wisdom*. The truth is, that the notion expressed by this term, as it is employed by our best writers, seems to presuppose the influence of some principles, the consideration of which belongs to a different part of my work. In confirmation of this, it may be remarked, that whereas

Before concluding these preliminary remarks, I cannot help expressing my regret, that the subject on which I am about to enter will so frequently lay me under the necessity of criticising the language, and of disputing the opinions of my predecessors. In doing so, I am not conscious of being at all influenced by a wish to indulge myself in the captiousness of controversy; nor am I much afraid of this

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the province of our reasoning powers (in their application to the business of life) is limited to the choice of *means*, *wisdom* denotes a power of a more comprehensive nature, and of a higher order; a power which implies a judicious selection both of *means* and of *ends*. It is very precisely defined by Sir William Temple, to be "that which makes men judge what are the best ends, and what the best means to attain them."

Of these two modifications of wisdom, the one denotes a power of the mind which obviously falls under the view of the logician; the examination of the other as obviously belongs to ethics.

A distinction similar to this was plainly in the mind of Cudworth, when he wrote the following passage, which, although drawn from the purest sources of ancient philosophy, will, I doubt not, from the uncouthness of the phraseology, have the appearance of extravagance, to many in the present times. To myself it appears to point at *a fact* of the highest importance in the moral constitution of man.

"We have all of us by nature *μαντευμα τι* (as both Plato and Aristotle call it) a certain *divination*, *presage*, and *parturient*, *vaticination* in our minds, of some higher good and perfection, than either *power* or *knowledge*. Knowledge is plainly to be preferred before power, as being that which guides and directs its blind force and impetus; but Aristotle himself declares, that there is λογȣ τι κρεῖττον, which is λογȣ αρχη; *something better than reason and knowledge, which is the principle and original of it.* For (saith he) λογȣ αρχη ȣ λογος, αλλα τι κρειττον. *The principle of reason is not reason, but something better.*"—*Intellectual System*, p. 203.

Lord Shaftesbury has expressed the same truth more simply and perspicuously in that beautiful sentence which occurs more than once in his writings: "True wisdom comes more from the heart than from the head."—Numberless illustrations of this profound maxim must immediately crowd on the memory of all who are conversant with the most enlightened works on the theory of legislation; more particularly, with those which appeared, during the eighteenth century, on the science of political economy.

imputation from any of my readers who shall honour these speculations with an attentive perusal. My real aim is, in the *first* place, to explain the grounds of my own deviations from the track which has been commonly pursued, and, *secondly*, to facilitate the progress of such as may follow me in the same path, by directing their attention to those points of divergency in the way, which may suggest matter for doubt or hesitation. I know, at the same time, that, in the opinion of many, the best mode of unfolding the principles of a science is to state them systematically and concisely, without any historical retrospects whatever; and I believe the opinion is well-founded, in those departments of knowledge, where the difficulty arises less from vague ideas and indefinite terms, than from the length of the logical chain which the student has to trace. But, in such disquisitions as we are now engaged in, it is chiefly from the gradual correction of verbal ambiguities, and the gradual detection of unsuspected prejudices, that a progressive, though slow approximation to truth is to be expected. It is indeed a slow approximation, at best, that we can hope to accomplish at present, in the examination of a subject where so many powerful causes (particularly those connected with the imperfections of language) conspire to lead us astray. But the study of the human mind is not, on that account, to be abandoned. Whoever compares its actual state with that in which Bacon, Des Cartes, and Locke, found it, must be sensible how amply their efforts for its improvement have been repaid, both by their own attainments, and by those of others who have since profited by their example. I am willing to hope, that some useful hints for its farther advancement, may be derived even from my own researches; and, distant as the prospect may be of raising it to a level with the physical science of the Newtonian school, by uniting the opinions of speculative men about fundamental principles, my ambition as an author will be fully gratified, if, by the few who are competent to judge, I shall be allowed to have contributed my share, however small, towards the attainment of so great an object.

In the discussions which immediately follow, no argument will, I trust, occur beyond the reach of those who shall read them with the attention which every inquiry into the human mind indispensably requires. I have certainly endeavoured, to the utmost of my abilities, to render every sentence which I have written, not only intelligible but perspicuous; and, where I have failed in the attempt, the obscurity will, I hope, be imputed, not to an affectation of mystery, but to some error of judgment. I can, without much vanity, say, that, with less expense of thought, I could have rivalled the obscurity of Kant; and that the invention of a new technical language, such as that which he has introduced, would have been an easier task, than the communication of clear and precise notions, (if I have been so fortunate as to succeed in this communication) without departing from the established modes ot expression.

To the following observations of D'Alembert (with some trifling verbal exceptions) I give my most cordial assent; and, mortifying as they may appear to the pretensions of bolder theorists, I should be happy to see them generally recognized as canons of philosophical criticism: Truth in metaphysics resembles truth in matters of taste. In both cases, the seeds of it exist in every mind; though few think of attending to this latent treasure, till it be pointed out to them by more curious inquirers. It should seem that every thing we learn from a good metaphysical book is only a sort of reminiscence of what the mind previously knew. The obscurity of which we are apt to complain in this science, may be always justly ascribed to the author; because the information which he professes to communicate requires no technical language appropriated to itself. Accordingly, we may apply to good metaphysical authors what has been said of those who excel in the art of writing, that in reading them, every body is apt to imagine, that he himself could have written in the same manner.

"But, in this sort of speculation, if all are qualified to understand, all are not fitted to teach. The merit of accommodating easily to the apprehension of others, notions which are at once simple and just, appears, from its extreme rarity, to be much greater than is commonly imagined. Sound metaphysical principles are truths which every one is ready to seize, but which few men have the talent of unfolding; so difficult is it in this, as well as in other instances, to appropriate to one's self the common inheritance of the human race."*

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* "Le vrai en métaphysique ressemble au vrai en matiere de goût; c'est un vrai dont tous les esprits ont le germe en eux-mêmes, auquel la plupart ne font point d'attention, mais qu'ils reconnoissent dès qu'on leur montre. Il semble que tout ce qu'on apprend dans un bon livre de métaphysique, ne soit qu'une espèce de réminiscence de ce que notre ame a déja su; l'obscurité, quand il y en a, vient toujours de la faute de l'auteur, parce que la science qu'il se propose d'enseigner n'a point d'autre langue que la langue commune. Aussi peut-on appliquer oux bons auteurs de métaphysique ce qu'on a dit des bons écrivains, qu'il n'y a personne qui en les lisant, ne croie pouvoir en dire autant qu'eux.

I am, at the same time, fully aware, that whoever, in treating of the human mind, aims to be understood, must lay his account with forfeiting, in the opinion of a very large proportion of readers, all pretensions to depth, to subtlety, or to invention. The acquisition of a new nomenclature is, in itself, no inconsiderable reward to the industry of those, who study only from motives of literary vanity; and, if D'Alembert's idea of this branch of science be just, the wider an author deviates from truth, the more likely are his conclusions to assume the appearance of discoveries. I may add, that it is chiefly in those discussions which possess the best claims to originality, where he may expect to be told by the multitude, that they have learned from him nothing but what they knew before.

The latitude with which the word *metaphysics* is frequently used, makes it necessary for me to remark, with respect to the foregoing passage from D'Alembert, that he limits the term entirely to an account of the origin of our ideas. "The generation of our ideas (he tells us) belongs to metaphyics. It forms one of the *principal* objects, and perhaps ought to form the *sole* object of that science."* If the meaning of the word be extended, as it too often is in

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Mais si dans ce genre tous sont faits pour entendre, tous ne sont pas faits pour instruire. Le mérite de faire entrer avec facilité dans les esprits des notions vraies et simples, est beaucoup plus grand qu'on ne pense, puisque l'expérience nous prouve combien il est rare; les saines idées métaphysiques sont des vérités communes que chacun saisit, mais que peu d'hommes ont le talent de développer; tant il est difficile, dans [illegible] se puisse être, de se rendre propre ce qui appartient à [illegible] de *Philosophie*.

* "La génération de nos idées appartient à [illegible]
ses objets principaux, et peut-être devroit e

our language, so as to comprehend all those inquiries which relate to the theory and to the improvement of our mental powers, some of his observations must be understood with very important restrictions. What he has stated, however, on the inseparable connexion between perspicuity of style and soundness of investigation in metaphysical disquisitions, will be found to hold equally in every research to which that epithet can, with any colour of propriety, be applied.

CHAPTER FIRST.

OF THE FUNDAMENTAL LAWS OF HUMAN BELIEF; OR THE PRIMARY ELEMENTS OF HUMAN REASON.

THE propriety of the title prefixed to this Chapter will, I trust, be justified sufficiently by the speculations which are to follow. As these differ, in some essential points, from the conclusions of former writers, I found myself under the necessity of abandoning, in various instances, their phraseology;—but my reasons for the particular changes which I have made, cannot possibly be judged of, or even understood, till the inquiries by which I was led to adopt them be carefully examined.

I begin with a review of some of those primary truths, a conviction of which is necessarily implied in all our thoughts and in all our actions; and which seem, on that account, rather to form constituent and essential *elements* of reason, than *objects* with which reason is conversant. The import of this last remark will appear more clearly afterwards.

The primary truths to which I mean to confine my attention at present are, 1. Mathematical Axioms: 2. Truths (or more properly speaking, Laws of Belief,) inseparably connected with the exercise of Consciousness, Perception, Memory, and Reasoning.—Of some additional laws of Belief, the truth of which is tacitly recognized in all our reasonings concerning contingent events, I shall have occasion to take notice under a different article.

SECTION I.

Of Mathematical Axioms.

I HAVE placed this class of truths at the head of the enumeration, merely because they seem likely, from the place which they hold in the elements of geometry, to present to my readers a more interesting, and at the same time, an easier subject of discussion, than some of the more abstract and latent elements of our knowledge, afterwards to be considered. In other respects, a different arrangement might perhaps have possessed some advantages, in point of strict logical method.

I.

On the evidence of mathematical axioms it is unnecessary to enlarge, as the controversies to which they have given occasion are entirely of a speculative, or rather scholastic description; and have no tendency to affect the certainty of that branch of science to which they are supposed to be subservient.

It must at the same time be confessed, with respect to this class of propositions (and the same remark may be extended to axioms in general,) that some of the logical questions connected with them continue still to be involved in much obscurity. In proportion to their extreme simplicity is the difficulty of illustrating or of describing their nature in unexceptionable language: or even of ascertaining a precise criterion by which they may be distinguished from other truths which approach to them nearly. It is chiefly owing to this, that, in geometry, there are no theorems of which it is so difficult to give a rigorous demonstration, as those, of which persons unacquainted with the nature of mathematical evidence are apt to say, that they require no proof whatever. But the inconveniencies arising from these circumstances are of trifling moment; occasioning, at the worst, some embarrassment to those mathematical writers, who are studious of the most finished elegance in their exposition of elementary principles; or to metaphysicians, anxious to display their subtilty upon points which cannot possibly lead to any practical conclusion.

It was long ago remarked by Locke, of the axioms of geometry, as stated by Euclid, that although the proposition be at first enunciated in *general* terms, and afterwards appealed to, in its *particular* applications, as a principle *previously* examined and admitted, yet that the truth is not less evident in the latter case than in the former. He observes farther, that it is in some of its particular applications, that the truth of every axiom is originally perceived by the mind; and, therefore, that the general proposition, so far from being the *ground* of our assent to the truths which it comprehends, is only a verbal generalization of what, in particular instances, has been already acknowledged as true.

The same author remarks, that some of these axioms "are no more than bare verbal propositions, and teach us nothing but the respect and import of names one to another. *The whole is equal to all its parts:* what real truth, I beseech you, does it teach us? What more is contained in that maxim, than what the signification of the word *totum*, or the *whole*, does of itself import? And he that knows that the word *whole* stands for what is made up of all its parts, knows very little less, than that 'the whole is equal to all its parts.' And upon the same ground, I think, that this proposition, *A hill is higher than a valley*, and several the like, may also pass for maxims."

Notwithstanding these considerations, Mr. Locke does not object to the form which Euclid has given to his axioms, or to the place which he has assigned to them in his Elements. On the contrary, he is of opinion, that a collection of such maxims is *not without reason* prefixed to a mathematical system; in order that learners, "having in the beginning perfectly acquainted their thoughts with these propositions made in general terms, may have them ready to apply to all particular cases as formed rules and sayings. Not that, if they be equally weighed, they are more clear and evident than the instances they are brought to confirm; but that, being more familiar to the mind, the very naming of them is enough to satisfy the understanding." In farther illustration of this, he adds very justly and ingeniously, that, "although our knowledge begins in particulars, and so spreads itself by degrees to generals; yet afterwards, the mind takes quite the contrary course, and having drawn its knowledge into as general propositions as it can, makes them familiar to its thoughts, and accustoms itself to have recourse to them, as to the standards of truth and falsehood."

But although, in mathematics, some advantage may be gained, without the risk of any possible inconvenience, from this arrangement of axioms, it is a very dangerous example to be followed in other branches of knowledge, where our notions are not equally clear and precise; and where the force of our pretended axioms (to use Mr. Locke's words) "reaching only to the sound, and not to the signification of the words, serves only to lead us into confusion, mistakes, and error." For the illustration of this remark, I must refer to Locke.

Another observation of this profound writer deserves our attention, while examining the nature of axioms;— "that they are not the foundations on which any of the sciences is built; nor at all useful in helping men forward to the discovery of unknown truths."* This observation I intend to illustrate afterwards, in treating of the futility of the syllogistic art. At present I shall only add, to what Mr. Locke has so well stated, that even in *mathematics*, it cannot with any propriety be said, that the axioms are the foundation on which the science rests; or the first principles from which its more recondite truths are deduced. Of this I have little doubt that Locke was perfectly aware; but the mistakes which some of the most acute and enlightened of his disciples have committed in treating of the same subject, convince me, that a further elucidation of it is not altogether superfluous.

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* Book iv. chap. 7. § 11.—2. 3.

With this view I shall here introduce a few remarks on a passage in Dr. Campbell's Philosophy of Rhetoric, in which he has betrayed some misapprehensions on this very point, which a little more attention to the hints already quoted from the Essay on Human Understanding might have prevented. These remarks will, I hope, contribute to place the nature of axioms, more particularly of mathematical axioms, in a different and clearer light than that in which they have been commonly considered.

"Of intuitive evidence (says Dr. Campbell) that of the following propositions may serve as an illustration: One and four make five. Things equal to the same thing are equal to one another. The whole is greater than a part; and, in brief, all axioms in arithmetic and geometry. These are, in effect, but so many expositions of our own general notions, taken in different views. Some of them are no more than definitions, or equivalent to definitions. To say, one and four make *five*, is precisely the same thing as to say, we give the name of *five* to one added to four. In fact, they are all in some respects reducible to this axiom, whatever is, is. I do not say they are deduced from it, for they have in like manner that original and intrinsic evidence, which makes them, as soon as the terms are understood, to be perceived intuitively. And, if they are not thus perceived, no deduction of reason will ever confer on them any additional evidence. Nay, in point of time, the discovery of the less general truths has the priority, not from their superior evidence, but solely from this consideration, that the less general are sooner objects of perception to us. But I affirm, that though not reduced from that axiom, they may be considered as particular exemplifications of it, and coincident with it, inasmuch as they are all implied in this, that the properties of our clear and adequate ideas can be no other than what the mind clearly perceives them to be.

"But, in order to prevent mistakes, it will be necessary further to illustrate this subject. It might be thought that, if axioms were propositions perfectly identical, it would be impossible to advance a step by their means, beyond the simple ideas first perceived by the mind. And it must be owned, if the predicate of the proposition were nothing but a repetition of the subject, under the same aspect, and in the same or synonymous terms, no conceivable advantage could be made of it for the furtherance of knowledge. Of such propositions, for instance, as these —seven are seven, eight are eight, and ten added to eleven are equal to ten added to eleven, it is manifest that we could never avail ourselves for the improvement of science. Nor does the change of the term make any alteration in point of utility. The propositions, twelve are a dozen, twenty are a score, unless considered as explications of the words *dozen* and *score*, are equally insignificant with the former. But when the thing, though in effect coinciding, is considered under a different aspect: when what is single in the subject is divided in the predicate, and conversely; or when what is a whole in the one is regarded as a part of something else in the other; such propositions lead to the discovery of innumerable and apparently remote relations. One added to four may be accounted no other than a definition of the word five, as was remarked above. But when I say, 'Two added to three are equal to five,' I advance a truth which, though equally clear, is quite distinct from the preceding. Thus, if one should affirm, 'That twice fifteen make thirty,' and again, that 'thirteen added to seventeen make thirty,' nobody would pretend that he had repeated the same proposition in other words. The cases are entirely similar. In both cases, the same thing is predicated of ideas which, taken severally, are different. From these again result other equations, as 'one added to four are equal to two added to three,' and 'twice fifteen are equal to thirteen added to seventeen.'

"Now, it is by the aid of such simple and elementary principles, that the arithmetician and algebraist proceed to the most astonishing discoveries. Nor are the operations of the geometrician essentially different."

I have little to object to these observations of Dr. Campbell, as far as they relate to arithmetic and to algebra; for, in these sciences, all our investigations amount to nothing more than to a comparison of different expressions of the same thing. Our common language indeed frequently supposes the case to be otherwise; as when an equation is defined to be, "A proposition asserting the equality of two quantities." It would, however, be much more correct to define it, "A proposition asserting the equivalence of two expressions of the same quantity;" for algebra is merely a *universal arithmetic*; and the names of numbers are nothing else than collectives, by which we are enabled to express ourselves more concisely than could be done by enumerating all the units that they contain. Of this doctrine, the passage now quoted from Dr. Campbell shows, that he entertained a sufficiently just and precise idea.

But, if Dr. Campbell perceived that arithmetical equations, such as "one and four make five," are no other than definitions, why should he have classed them with the axioms he quotes from Euclid, "That the whole is greater than a part," and that "Things equal to the same thing are equal to one another;" propositions which, however clearly their truth be implied in the meaning of the terms of which they consist, cannot certainly, by any interpretation, be considered in the light of definitions at all analogous to the former? The former, indeed, are only explanations of the relative import of particular names; the latter are universal propositions, applicable alike to an infinite variety of instances.[*]

Another very obvious consideration might have satisfied Dr. Campbell, that the simple arithmetical equations which he mentions, do not hold the same place in that science which Euclid's axioms hold in geometry. What I allude to is, that the greater part of these axioms are equally essential to all the different branches of mathematics. That "the whole is greater than a part," and that "things equal to the same thing are equal to one another," are propositions as essentially connected with our arithmetical computations, as with our geometrical reasonings; and, therefore, to explain in what manner the mind makes a transition, in the case of numbers, from the more simple to the more complicated equations, throws no light whatever on the question, *how* the transition is made, either in arithmetic or in geometry, from what are properly called axioms, to the more remote conclusions in these sciences.

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[*] D'Alembert also has confounded these two classes of propositions. "What do the greater part of those axioms on which geometry prides itself amount to, but to an expression, by means of two different words or signs, of the same simple idea? He who says that two and two make four, what more does he know than another who should content himself with saying, that two and two make two and two?"——Here, a simple arithmetical equation (which is obviously a mere *definition*) is brought to illustrate a remark on the nature of geometrical axioms.——With respect to these last (I mean such axioms as Euclid has prefixed to his Elements) D'Alembert's opinion seems to coincide exactly with that of Locke, already mentioned "I would not be understood, nevertheless, to condemn the use of them altogether: I wish only to remark, that their utility rises no higher than this, that they render our simple ideas more familiar by means of habit, and better adapted to the different purposes to which we may have occasion to apply them."—"Je ne prétends point cependant en condamner absolument l'usage: je veux seulement faire observer, à quoi il se reduit; c'est à nous rendre les idées simples plus familières par l'habitude, et plus propres aux différens usages auxquels nous pouvons les appliquer."—*Discours Preliminaire*, &c. &c.

The very fruitless attempt thus made by this acute writer to illustrate the importance of axioms as the basis of mathematical truth, was probably suggested to him by a doctrine which has been repeatedly inculcated of late, concerning the grounds of that peculiar evidence which is allowed to accompany mathematical demonstration. "All the sciences, (it has been said) rest ultimately on first principles, which we must take for granted without proof; and whose evidence determines, both in kind and degree, the evidence which it is possible to attain in our conclusions. In some of the sciences, our first principles are intuitively certain; in others, they are intuitively probable; and such as the evidence of these principles is, such must that of our conclusions be. If our first principles are intuitively certain, and if we reason from them consequentially, our conclusions will be demonstratively certain: but if our principles be only intuitively probable, our couclusions will be only demonstratively probable. In mathematics, the first principles from which we reason are a set of axioms which are not only intuitively certain, but of which we find it impossible to conceive the contraries to be true: And hence the peculiar evidence which belongs to all the conclusions that follow from these principles as necessary consequences."

To this view of the subject, Dr. Reid has repeatedly given his sanction, at least in the most essential points; more particularly, in controverting an assertion of Locke's, that "no science is, or hath been built on *maxims*."—"Surely (says Dr. Reid) Mr. Locke was not ignorant of geometry, which hath been built upon maxims prefixed to the Elements, as far back as we are able to trace it. But though they had not been prefixed, which was a matter of utility rather than necessity, yet it must be granted, that every demonstration in geometry is grounded, either upon propositions formerly demonstrated, or upon self-evident principles."*

On another occasion, he expresses himself thus: "I take it to be certain, that whatever can, by just reasoning, be inferred from a principle that is necessary, must be a necessary truth. Thus, as the axioms in mathematics are all necessary truths, so are all the conclusions drawn from them; that is, the whole body of that science."†

That there is something fundamentally erroneous in these very strong statements with respect to the relation which Euclid's axioms bear to the geometrical theorems which follow, appears sufficiently from a consideration which was long ago mentioned by Locke,—that from those axioms it is not possible for human ingenuity to deduce a single inference. "It was not (says Locke) the influence of those maxims which are taken for principles in mathematics that hath led the masters of that science into those wonderful discoveries they have made. Let a man of good parts know all the maxims generally made use of in mathematics never so perfectly, and contemplate their extent and consequences as much as he pleases, he will, by their assistance, I suppose, scarce ever come to know, that 'the square of the hypothenuse in a right angled triangle, is equal to the squares of the two other sides.' The knowledge that 'the whole is equal to all its parts,' and, 'if you take equals from equals, the remainders will be equal,' helped him not, I presume, to this demonstration: And a man may, I think, pore long enough on those axioms, without ever seeing one jot the more of mathematical truths."* But surely, if this be granted, and if, at the same time, by the first principles of a science be meant, those fundamental propositions from which its remoter truths are derived, the axioms cannot, with any consistency, be called the First Principles of Mathematics. They have not (it will be admitted) the most distant analogy to what are called the first principles of natural philosophy;—to those general facts, for example, of the gravity and elasticity of the air, from which may be deduced, as consequences, the suspension of the mercury in the Torricellian tube, and its fall when carried up to an eminence. According to this meaning of the word, the principles of mathematical science are, *not* the axioms but the *definitions;* which definitions hold, in mathematics, precisely the same place that is held in natural philosophy by such general facts as have now been referred to.*

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* Essays on Intell. Powers, p. 647, 4to edit.

† Ibid. p. 577. See also pp. 560, 561, 606.

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* Essay on Human Understanding, Book IV. chap. xii. § 15.

From what principle are the various properties of the circle derived, but from the definition of a circle? From what principle the properties of the parabola or ellipse, but from the definitions of these curves? A similar observation may be extended to all the other theorems which the mathematician demonstrates: And it is this observation (which, obvious as it may seem, does not appear to have occurred, in all its force, either to Locke, to Reid, or to Campbell,) that furnishes, if I mistake not, the true explanation of the peculiarity already remarked in mathematical evidence.*

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* In order to prevent cavil, it may be necessary for me to remark here, that when I speak of mathematical axioms, I have in view only such as are of the same description with the *first nine* of those which are prefixed to the Elements of Euclid; for, in that list, it is well known, that there are several which belong to a class of propositions altogether different from the others. That "all right angles (for example) are equal to one another;" that "when one straight line falling on two other straight lines makes the two interior angles on the same side less than two right angles, these two straight lines, if produced, shall meet on the side, where are the two angles less than two right angles;" are manifestly principles which bear no analogy to such barren *truisms* as these, "Things that are equal to one and the same thing are equal to one another." "If equals be added to equals, the wholes are equal." "If equals be taken from equals, the remainders are equal." Of these propositions, the two former (the 10th and 11th axioms, to wit, in Euclid's list) are evidently theorems which, in point of strict logical accuracy, ought to be demonstrated; as may be easily done, with respect to the first, in a single sentence. That the second has not yet been proved in a simple and satisfactory manner, has been long considered as a sort of reproach to mathematicians; and I have little doubt that this reproach will continue to exist, till the basis of the science be somewhat enlarged, by the introduction of one or two new definitions, to serve as additional principles of geometrical reasoning.

For some farther remarks on Euclid's Axioms, see note (A.)

The edition of Euclid to which I uniformly refer, is that of David Gregory. Oxon. 1713.

The prosecution of this last idea properly belongs to the subject of mathematical demonstration, of which I intend to treat afterwards. In the meantime, I trust, that enough has been said to correct those misapprehensions of the nature of axioms, which are countenanced by the speculations, and still more by the phraseology, of some late eminent writers. On this article, my own opinion coincides very nearly with that of Mr. Locke—both in the view which he has given of the nature and use of axioms in geometry, and in what he has so forcibly urged concerning the danger, in other branches of knowledge, of attempting a similar list of *maxims*, without a due regard to the circumstances by which different sciences are distinguished from one another. With Mr. Locke, too, I must beg leave to guard myself against the possibility of being misunderstood in the illustrations which I have offered of some of his ideas: And for this purpose, I cannot do better than borrow his words. "In all that is here suggested concerning the little use of axioms for the improvement of knowledge, or dangerous use in undetermined ideas, I have been far enough from saying or intending they should be laid aside, as some have been too forward to charge me. I affirm them to be truths, self-evident truths; and so cannot be laid aside. As far as their influence will reach, it is in vain to endeavour, nor would I attempt to abridge it. But yet, without any injury to truth or knowledge, I may have reason to think their use is not answerable to the great stress which seems to be laid on them, and I may warn men not to make an ill use of them, for the confirming themselves in error."*

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* D'Alembert, although he sometimes seems to speak a different language, approached nearly to this view of the subject when he wrote the following passage:

"Finally, it is not without reason that mathematicians consider *definitions* as *principles*; since it is on clear and precise definitions that our knowledge rests in those sciences, where our reasoning powers have the widest field opened for their exercise."—"Au reste, ce n'est pas sans raison que les mathématiciens regardent les définitions comme des principes, puisque, dans les sciences ou le raisonnement a la meilleure part, c'est sur des définitions nettes et exactes que nos connoissances sont appuyées."—*Elemens de Phil.* p. 4

After what has been just stated, it is scarcely necessary for me again to repeat, with regard to mathematical axioms; that although they are not the *principles* of our reasoning, either in arithmetic or geometry, their truth is supposed or implied in all our reasonings in both; and, if it were called in question, our further progress would be impossible. In both of these respects, we shall find them analogous to the other classes of primary or elemental truths which remain to be considered.

Nor let it be imagined, from this concession, that the dispute turns merely on the meaning annexed to the word *principle*. It turns upon an important question of fact; Whether the theorems of geometry rest on the *axioms*, in the same sense in which they rest on the *definitions?* or (to state the question in a manner still more obvious,) Whether axioms hold a place in geometry at all analogous to what is occupied in natural philosophy, by those sensible phenomena which form the basis of that science? Dr. Reid compares them sometimes to the one set of propositions and sometimes to the other.[*] If the foregoing observations be just, they bear no analogy to either.

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* Locke's Essay, Book IV. ch. vii. § 14

Into this indistinctness of language Dr. Reid was probably led in part by Sir Isaac Newton, who, with a very illogical latitude in the use of words, gave the name of *axioms* to the *laws of motion*,[†] and also to those general experimental truths which form the ground-work of our general reasonings in catoptrics and dioptrics. For such a misapplication of the technical terms of mathematics some apology might perhaps be made, if the author had been treating on any subject connected with moral science; but surely, in a work entitled "Mathematical Principles of Natural Philosophy," the word *axiom* might reasonably have been expected to be used in a sense somewhat analogous to that which every person liberally educated is accustomed to annex to it, when he is first initiated into the elements of geometry.

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[*] "Mathematics, once fairly established on the foundation of a few *axioms and definitions*, as upon a rock, has grown from age to age, so as to become the loftiest and the most solid fabric that human reason can boast."—*Essays on Int. Powers*, p. 561, 4to edition.

"Lord Bacon first delineated the only solid foundation on which natural philosophy can be built; and Sir Isaac Newton reduced the principles laid down by Bacon into three or four *axioms*, which he calls *regulæ philosophandi*. From these, *together with the phenomena observed by the senses, which he likewise lays down as first principles*, he deduces, by strict reasoning, the propositions contained in the third book of his Principia, and in his Optics; and by this means has raised a fabric, which is not liable to be shaken by doubtful disputation, but stands immoveable on the basis of self-evident principles."—Ibid. See also pp. 647, 648.

[†] Axiomata, sive leges Motus. Vid. *Philosophiæ Naturalis Principia Mathematica*.

At the beginning too, of Newton's Optics, the title of axioms is given to the following propositions:

AXIOM I.

"The angles of reflection and refraction lie in one and the same plane with the angle of incidence.

AXIOM II.

"The angle of reflection is equal to the angle of incidence.

AXIOM III.

"If the refracted ray be turned directly back to the point of incidence, it shall be refracted into the line before described by the incident ray.

The question to which the preceding discussion relates is of the greater consequence, that the prevailing mistake with respect to the nature of mathematical axioms, has contributed much to the support of a very erroneous theory concerning mathematical evidence, which is, I believe, pretty generally adopted at present,—that it all resolves ultimately into the perception of *identity*; and that it is this circumstance which constitutes the peculiar and characteristical cogency of mathematical demonstration.

AXIOM IV.

"Refraction out of the rarer medium into the denser, is made towards the perpendicular; that is, so that the angle of refraction be less than the angle of incidence.

AXIOM V.

"The sine of incidence is either accurately, or very nearly in a given ratio to the sine of refraction."

When the word *axiom* is understood by one writer in the sense annexed to it by Euclid, and by his antagonist in the sense here given to it by Sir Isaac Newton, it is not surprising that there should be apparently a wide diversity between their opinions concerning the logical importance of this class of propositions.

Of some of the other arguments which have been alleged in favour of this theory, I shall afterwards have occasion to take notice. At present it is sufficient for me to remark, (and this I flatter myself I may venture to do with some confidence, after the foregoing reasonings,) that in so far as it rests on the supposition that geometrical truths are ultimately derived from Euclid's axioms, it proceeds on an assumption totally unfounded in fact, and indeed so obviously false, that nothing but its antiquity can account for the facility with which it continues to be admitted by the learned.*

SECTION I.

II.

Continuation of the same Subject.

THE difference of opinion between Locke and Reid, of which I took notice in the foregoing part of this section, appears greater than it really is, in consequence of an ambiguity in the word *principle*, as employed by the latter.

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* A late mathematician of considerable ingenuity and learning, doubtful, it should seem, whether Euclid had laid a sufficiently broad foundation for mathematical science in the axioms prefixed to his Elements, has thought proper to introduce several new ones of his own invention. The first of these is, that "Every quantity is equal to itself;" to which he adds afterwards, that "A quantity expressed one way is equal to itself expressed any other way."—*See Elements of Mathematical Analysis, by Professor Vilant of Saint Andrews.* We are apt to smile at the formal statement of these propositions; and yet, according to the theory alluded to in the text, it is in truths of this very description that the whole science of mathematics not only begins but ends. Omnes mathematicorum propositiones sunt identicæ, et repræsentantur hac formula, "$a = a$." This sentence, which I

In its proper acceptation, it seems to me to denote an assumption (whether resting on fact or on hypothesis) upon which, as a *datum*, a train of reasoning proceeds; and for the falsity or incorrectness of which no logical rigour in the subsequent process can compensate. Thus the gravity and the elasticity of the air are *principles of reasoning* in our speculations about the barometer. The equality of the angles of incidence and reflection; the proportionality of the sines of incidence and refraction; are *principles of reasoning* in catoptrics and in dioptrics. In a sense perfectly analogous to this, the *definitions* of geometry (all of which are merely *hypothetical*) are the *first principles* of reasoning in the subsequent demonstrations, and the basis on which the whole fabric of the science rests.

I have called this the *proper* acceptation of the word, because it is that in which it is most frequently used by the best writers. It is also most agreeable to the literal meaning which its etymology suggests, expressing the original point from which our reasoning sets out or commences.

Dr. Reid often uses the word in this sense, as, for example, in the following sentence, already quoted: " From three or four axioms, which he calls *regulæ philosophandi*, together with *the phenomena observed by the senses*,

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quote from a dissertation, published at Berlin about fifty years ago, expresses, in a few words, what seems to be now the prevailing opinion, (more particularly on the Continent) concerning the nature of mathematical evidence. The remarks which I have to offer upon it, I delay till some other questions shall be previously considered.

which he likewise lays down as first principles, Newton deduces, by strict reasoning, the propositions contained in the third book of his Principia, and in his Optics."

On other occasions, he uses the same word to denote those *elemental* truths (if I may use the expression,) which are virtually taken for granted or assumed, in every step of our reasoning; and without which, although no *consequences* can be directly inferred from them, a train of reasoning would be impossible. Of this kind in mathematics, are the *axioms*, or (as Mr. Locke and others frequently call them,) the *maxims*; in physics, a belief of *the continuance of the Laws of Nature*; in all our reasonings, without exception, a belief *in our own identity*, and in the *evidence of memory*. Such truths are the *last elements* into which reasoning resolves itself, when subjected to a metaphysical analysis; and which no person but a metaphysician or a logician ever thinks of stating in the form of propositions, or even of expressing verbally to himself. It is to truths of this description that Locke seems in general to apply the name of *maxims*; and in this sense, it is unquestionably true, that no science (not even geometry) is founded on maxims as its first principles.

In one sense of the word *principle*, indeed, maxims may be called principles of reasoning; for the words *principles* and *elements* are sometimes used as synonymous. Nor do I take upon me to say that this mode of speaking is exceptionable. All that I assert is, that they cannot be called *principles of reasoning*, in the sense which has just now been defined; and that accuracy requires, that the word, on which the whole question hinges, should not be used in both senses, in the course of the same argument.

It is for this reason that I have employed the phrase *principles of reasoning* on the one occasion, and *elements of reasoning* on the other.

It is difficult to find unexceptionable language to mark distinctions so completely foreign to the ordinary purposes of speech ; but, in the present instance, the line of separation is strongly and clearly drawn by this criterion,—that from *principles of reasoning* consequences may be deduced ; from what I have called *elements of reasoning*, none ever can.

A process of logical reasoning has been often likened to a chain supporting a weight. If this similitude be adopted, the *axioms* or *elemental truths* now mentioned, may be compared to the successive concatenations which connect the different links immediately with each other ; the *principles* of our reasoning resemble the hook, or rather the beam, from which the whole is suspended.

The foregoing observations, I am inclined to think, coincide with what was, at bottom, Mr. Locke's opinion on this subject. That he has not stated it with his usual clearness and distinctness, it is impossible to deny ; at the same time, I cannot subscribe to the following severe criticism of Dr. Reid :

"Mr. Locke has observed, 'That intuitive knowledge is necessary *to connect* all the steps of a demonstration.'

"From this, I think, it necessarily follows, that in every branch of knowledge, we must make use of truths that are intuitively known, in order to *deduce from them* such as require proof.

"But I cannot reconcile this with what he says, (section 8th of the same chapter;) 'The necessity of this intuitive knowledge in every step of scientifical or demonstrative reasoning, gave occasion, I imagine, to that mistaken axiom, that all reasonings was *ex præcognitis et præconcessis,* which how far it is mistaken I shall have occasion to show more at large when I come to consider propositions, and particularly those propositions which are called maxims, and to show that it is by a mistake that they are supposed to be the foundation of all our knowledge and reasonings."*

The distinction which I have already made between *elements* of reasoning, and *first principles* of reasoning, appears to myself to throw much light on these apparent contradictions.

That the seeming difference of opinion on this point between these two profound writers, arose chiefly from the ambiguities of language, may be inferred from the following acknowledgment of Dr. Reid, which immediately follows the last quotation:

"I have carefully examined the chapter on maxims, which Mr. Locke here refers to, and though one would expect, from the quotation last made, that it should run contrary to what I have before delivered concerning first principles, I find only two or three sentences in it, and those chiefly incidental, to which I do not assent."[*]

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* Essays on Int. Powers, p. 643, 4to edit.

Before dismissing this subject, I must once more repeat, that the doctrine which I have been attempting to establish, so far from degrading *axioms* from that rank which Dr. Reid would assign them, tends to identify them still more than he has done with the exercise of our reasoning powers; inasmuch as, instead of comparing them with the *data*, on the accuracy of which that of our conclusion necessarily depends, it considers them as the *vincula* which give coherence to all the particular links of the chain; or, (to vary the metaphor) as *component elements*, without which the faculty of reasoning is inconceivable and impossible.[†]

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[*] Essays on Int. Powers, p. 643, 4to edit.

[†] D'Alembert has defined the word *principle* exactly in the sense in which I have used it; and has expressed himself (at least on one occasion) nearly as I have done, on the subject of axioms. He seems however on this, as well as on some other logical and metaphysical questions, to have varied a little in his views (probably from mere forgetfulness) in different parts of his writings.

"What then are the truths which are entitled to have a place in the elements of philosophy? They are of two kinds; *those which form the head of each part of the chain*, and those which are to be found at the points where different branches of the chain unite together.

"Truths of the first kind are distinguished by this—that they do not depend on any other truths, and that they possess within themselves the whole grounds of their evidence. Some of my readers will be apt to suppose, that I here mean to speak of *axioms*; but these are not the truths which I have at present in view. With respect to this last class of *principles*, I must refer to what I have elsewhere said of them; that, notwithstanding their truth, they add nothing to our information; and that the palpable evidence which accompanies them, amounts to nothing more than to an expression of the same idea by means of two different terms. On such occasions,

SECTION II.

Of certain Laws of Belief, inseparably connected with the exercise of Consciousness, Memory, Perception, and Reasoning.

1. It is by the immediate evidence of consciousness that we are assured of the *present existence* of our various

the mind only turns to no purpose about its own axis, without advancing forward a single step. Accordingly, axioms are so far from holding the highest rank in philosophy, that they scarcely deserve the distinction of being formally enunciated."

["Or quelles sont les vérités qui doivent entrer dans des élémens de philosophie? Il y en a de deux sortes: *celles qui forment la tête de chaque partie de la chaine*, et celles qui se trouvent au point de réunion de plusieurs branches.

"Les vérités du premier genre ont pour caractère distinctif de ne dépendre d'aucune autre, et de n'avoir de preuves que dans elles-mêmes. Plusieurs lecteurs croiront que nous voulons parler des axiomes, et ils se tromperont; nous les renvoyons à ce que nous en avons dit ailleurs, que ces *sortes de principes* ne nous apprennent rien à force d'être vrais, et que leur evidence palpable et grossière se reduit à exprimer la même idée par deux termes différens, l'esprit ne fait alors autrechose que tourner inutilement sur lui-même sans avancer d'un seul pas. Ainsi les axiomes bien loin de tenir en philosophie le premier rang n'ont pas même besoin d'être enoncés." —*Elem. de Phil.* pp. 24, 25.

Although, in the foregoing passage, D'Alembert, in compliance with common phraseology, has bestowed the name of principles upon axioms, it appears clearly, from a question which occurs afterwards, that he did not consider them as well entitled to this appellation. "What are then," he asks, "in each science, the *true principles* from which we ought to set out?" ("Quels sont donc dans chaque science les vrais *principes* d'où l'on doit partir?") The answer he gives to this question agrees with the doctrine I have stated in every particular, excepting in this, that it represents (and in my opinion very incorrectly) the principles of geometrical science to be (not sensations, whether pleasant or painful; of all our affections, passions, hopes, fears, desires, and volitions. It is thus too we are assured of the *present existence* of those thoughts which, during our waking hours, are continually passing through the mind, and of all the different effects which they produce in furnishing employment to our intellectual faculties.

According to the common doctrine of our best philosophers,* it is by the evidence of *consciousness* we are assured that we ourselves exist. The proposition, however, when thus stated, is not accurately true; for our own existence (as I have elsewhere observed,†) is not a direct or immediate object of consciousness, in the strict and logical meaning of that term. We are conscious of

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definitions or hypotheses, but) those simple and acknowledged *facts*, which our senses perceive with respect to the properties of *extension*. "The *true principles* from which we ought to set out in the different sciences, are simple and acknowledged *facts*, which do not presuppose the existence of any others, and which, of course, it is equally vain to attempt explaining or confuting; in physics, the familiar phenomena which daily experience presents to every eye; *in geometry, the sensible properties of extension;* in mechanics, the impenetrability of bodies, upon which their mutual actions depend; in metaphysics, the results of our sensations; in morals, the original and common affections of the human race."—["Les vrais principes d'ou l'on doit patir dans chaque science, sont des faits simples et reconnus, qui n'en supposent point d'autres, et qu'on ne puisse par consequent ni expliquer ni contester; en physique les phénomenes journaliers que l'observation découvre à tous les yeux; *en géometrie les proprietés sensibles de l'etendue;* en me chanique, l'impenetrabilité des corps, source de leur action mutuelle; en métaphysique, le résultat de nos sensations; en morale, les affections premières et communes à tous les hommes."—pp. 26, 27.]

In cases of this sort, where so much depends on extreme precision and nicety in the use of words, it appears to me to be proper to verify the fidelity of my translations by subjoining the original passages.

* See, in particular, Campbell's Philosophy of Rhetoric.

† Philosophical Essays, p. 7.

sensation, thought, desire, volition: but we are not conscious of the existence of mind itself; nor would it be possible for us to arrive at the knowledge of it (supposing us to be created in the full possession of all the intellectual *capacities* which belong to human nature,) if no impression were ever to be made on our external senses. The moment that, in consequence of such an impression, a sensation is excited, we learn two facts at once;—the existence of the sensation, and our own existence as sentient beings;—in other words, the very first exercise of consciousness necessarily implies a belief, not only of the present existence of what is felt, but of the present existence of *that* which feels and thinks; or (to employ plainer language) the present existence of that being which I denote by the words *I* and *myself*. Of these facts, however, it is the former alone of which we can properly be said to be conscious, agreeably to the rigorous interpretation of the expression. A conviction of the latter, although it seems to be so inseparable from the exercise of consciousness, that it can scarcely be considered as posterior to it in the order of *time*, is yet (if I may be allowed to make use of a scholastic distinction) posterior to it in the order of *nature;* not only as it supposes consciousness to be already awakened by some sensation, or some other mental affection; but as it is evidently rather a judgment accompanying the exercise of that power, than one of its immediate intimations concerning its appropriate class of internal phenomena. It appears to me, therefore, more correct to call the belief of our own existence a concomitant or accessory of the exercise of consciousness, than to say, that our existence is a fact falling under the immediate cognizance of consciousness, like the existence of the various agreeable or painful sensations which external objects excite in our minds.

2. That we cannot, without a very blameable latitude in the use of words, be said to be *conscious* of our personal identity, is a proposition still more indisputable: inasmuch as the very idea of personal identity involves the idea of *time*, and consequently presupposes the exercise not only of *consciousness*, but of *memory*. The belief connected with this idea is implied in every thought and every action of the mind, and may be justly regarded as one of the simplest and most essential elements of the understanding. Indeed it is impossible to conceive either an intellectual or an active being to exist without it. It is, however, extremely worthy of remark, with respect to this belief, that, universal as it is among our species, nobody but a metaphysician ever thinks of expressing it in words, or of reducing into the shape of a proposition, the truth to which it relates. To the rest of mankind, it forms not an object of knowledge; but a condition or supposition, necessarily and unconsciously involved in the exercise of all their faculties. On a part of our constitution, which is obviously one of the last or primordial elements at which it is possible to arrive in analyzing our intellectual operations, it is plainly unphilosophical to suppose, that any new light can be thrown by metaphysical discussion. All that can be done with propriety, in such cases, is to state the fact.

And here, I cannot help taking notice of the absurd and inconsistent attempts which some ingenious men have made, to explain the gradual process by which they suppose the mind to be led to the knowledge of its own existence, and of that continued identity which our constitution leads us to ascribe to it. How (it has been asked) does a child come to form the very abstract and metaphysical idea expressed by the pronoun *I* or *moi?* In answer to this question, I have only to observe, that when we set about the explanation of a phenomenon, we must proceed on the supposition that it is possible to resolve it into some more general law or laws with which we are already acquainted. But in the case before us, how can this be expected, by those who consider that all our knowledge of mind is derived from the exercise of reflection; and that every act of this power implies a conviction of our own existence as reflecting and intelligent beings? Every theory, therefore, which pretends to account for this conviction, must necessarily involve that sort of paralogism which logicians call a *petitio principii;* inasmuch as it must resolve the thing to be explained into some law or laws, the evidence of which rests ultimately on the assumption in question. From this assumption, which is necessarily implied in the joint exercise of consciousness and memory, the philosophy of the human mind, if we mean to study it analytically, must of necessity set out; and the very attempt to dig deeper for its foundation, betrays a total ignorance of the logical rules, according to which alone it can ever be prosecuted with any hopes of success.

It was, I believe, first remarked by Mr. Prevost of Geneva, (and the remark, obvious as it may appear, reflects much honour on his acuteness and sagacity) that the inquiries concerning the mind, founded on the hypothesis of the *animated statue*—inquiries which both Bonnet and Condillac professed to carry on analytically,—were in truth altogether synthetical. To this criticism it may be added, that their inquiries, in so far as they had for their object to explain the origin of our belief of our own existence, and of our personal identity, assumed, as the principles of their synthesis, facts at once less certain and less familiar than the problem which they were employed to resolve.

Nor is it to the metaphysician only, that the ideas of identity and of personality are familiar. Where is the individual who has not experienced their powerful influence over his imagination, while he was employed in reflecting on the train of events which have filled up the past history of his life; and on that internal world, the phenomena of which have been exposed to his own inspection alone? On such an occasion, even the wonders of external nature seem comparatively insignificant; and one is tempted (with a celebrated French writer) in contemplating the spectacle of the universe, to adopt the words of the Doge of Genoa when he visited Versailles—" Ce qui m'etonne le plus ici, c'est de m'y voir."*

3. The belief which all men entertain of the existence of the material world, (I mean their belief of its existence independently of that of percipient beings) and their expectation of the continued uniformity of the laws of nature, belong to the same class of ultimate or elemental laws of thought, with those which have been just mentioned. The truths which form their objects are of an order so radically different from what are commonly called *truths*, in the popular acceptation of the word, that it might perhaps be useful for logicians to distinguish them

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* D'Alembert, Apologie de l'Etude.

by some appropriate appellation, such, for example, as that of *metaphysical* or *transcendental* truths. They are not *principles* or *data* (as will afterwards appear) from which any consequence can be deduced; but form a part of those original *stamina* of human reason, which are equally essential to all the pursuits of science, and to all the active concerns of life.

4. I shall only take notice farther, under this head, of the confidence which we must necessarily repose in the evidence of memory (and I may add, in the continuance of our personal identity) when we are employed in carrying on any process of deduction or argumentation; in following out, for instance, the steps of a long mathematical demonstration. In yielding our assent to the conclusion to which such a demonstration leads, we evidently trust to the fidelity with which our memory has connected the different links of the chain together. The reference which is often made, in the course of a demonstration, to propositions formerly proved, places the same remark in a light still stronger; and shows plainly that, in this branch of knowledge, which is justly considered as the most certain of any, the authority of the same laws of belief which are recognized in the ordinary pursuits of life, is tacitly acknowledged. Deny the evidence of memory as a ground of certain knowledge, and you destroy the foundations of mathematical science as completely as if you were to deny the truth of the axioms assumed by Euclid.

The foregoing examples sufficiently illustrate the nature of that class of truths which I have called *Fundamental Laws of Human Belief*, or *Primary Elements of Human Reason*. A variety of others, not less important might be added to the list;* but these I shall not at present stop to enumerate, as my chief object, in introducing the subject here, was to explain the common relation in which they all stand to deductive evidence. In this point of view two analogies, or rather coincidences, between the truths which we have been last considering, and the mathematical axioms which were treated of formerly, immediately present themselves to our notice.

1. From neither of these classes of truths can any direct inference be drawn for the farther enlargement of our knowledge. This remark has been already shown to hold universally with respect to the axioms of geometry; and it applies equally to what I have called Fundamental Laws of Human Belief. From such propositions as these, *I exist; I am the same person to-day that I was yesterday; the material world has an existence independent of my mind; the general laws of nature will continue, in future, to operate uniformly as in time past*, no inference can be deduced, any more than from the intuitive truths prefixed to the Elements of Euclid. Abstracted from other *data*, they are perfectly barren in themselves; nor can any possible combination of them help the mind forward, one single step, in its progress. It is for this reason, that instead of calling them, with some other writers, *first principles*, I have distinguished them by the title of *fundamental laws of belief;* the former word seeming to me to denote, according to common usage, some *fact*, or

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* Such for example, as our belief of the existence of *efficient* causes; our belief of the existence of other intelligent beings besides ourselves, &c. &c.

some *supposition*, from which a series of consequences may be deduced.

If the account now given of these *laws of belief* be just, the great argument which has been commonly urged in support of their authority, and which manifestly confounds them with what are properly called *principles of reasoning*,* is not at all applicable to the subject; or at least does not rest the point in dispute upon its right foundation. If there were no first principles (it has been said) or, in other words, if a reason could be given for every thing, no process of deduction could possibly be brought to a conclusion. The remark is indisputably true; but it only proves (what no logician of the present times will venture to deny) that the mathematician could not demonstrate a single theorem, unless he were first allowed to lay down his definitions; nor the natural philosopher explain or account for a single phenomenon, unless he were allowed to assume, as acknowledged facts, certain general laws of nature. What inference does this afford in favour of that particular class of truths to which the preceding observations relate, and against which the ingenuity of modern sceptics has been more particularly directed? If I be not deceived, these truths are still more intimately connected with the operations of the reasoning faculty than has been generally imagined; not as the *principles* (αρχαι) from which our reasonings set out, and on which they ultimately depend; but as the necessary *conditions* on which every step of the deduction tacitly proceeds; or rather (if I may use the expression) as essential elements which enter into the composition of reason itself.

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* Aristotle himself has more than once made this remark; more particularly, in discussing the absurd question, Whether it be possible for the same thing to be and not to be? *αξιουσι δε και τουτο αποδεικνυναι τινες δι απαιδευσιαν. εστι γαρ απαιδευσια, το μη γινωσκειν τινων δει ζητειν αποδειξιν, και τινων ου δει. ὁλως μεν γαρ ἁπαντων αδυνατον αποδειξιν ειναι. εις απειρον γαρ αν βαδιζοι· ὡστε μηδ᾽ ὁυτως ειναι αποδειξιν.*—*Aristot. Metaphys.* Vol. II. p. 873. Edit. Du Val.

"But there are some who, through ignorance, make an attempt to prove even this principle, (that it is impossible for the same thing to be and not to be.) For it is a mark of ignorance, not to be able to distinguish those things which ought to be demonstrated from things of which no demonstration should be attempted. In truth, it is altogether impossible that every thing should be susceptible of demonstration; otherwise the process would extend to infinity, and, after all our labour, nothing would be gained." In the sentence immediately preceding this quotation, Aristotle calls the maxim in question, *βεβαιοτατη των αρχων πασων*, "the most certain of all *principles*."

To the same purpose Dr. Reid has said: "I hold it to be certain and even demonstrable, that all knowledge got by reasoning must be built on first principles. This (he adds) is as certain as that every house must have a foundation."—*Essays on Int. Powers*, p. 558. 4to edit.

2. In this last remark, I have anticipated, in some measure, what I had to state with respect to the *second* coincidence alluded to, between mathematical axioms, and the other propositions which I have comprehended under the general title of *fundamental laws of human belief.* As the truth of axioms is virtually presupposed or implied in the successive steps of every demonstration, so, in every step of our reasonings concerning the order of Nature, we proceed on the supposition, that the laws by which it is regulated will continue uniform as in time past; and that the material universe has an existence independent of our perceptions. I need scarcely add, that, in all our reasonings whatever, whether they relate to necessary or to contingent truths, our own personal identity, and the evi-

ken for granted. These
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rational powers; although,
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arrangements and *metaphysical*
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these two analogies or coincidences.
clined to comprehend, under the ge-
s, all the truths which have been hi-
view, if the common usage of our lan-
a great measure, appropriated that ap-
xioms of mathematics; and if the view of
I have taken, did not render it necessa-
ect the attention of my readers to the
between the branches of knowledge to
respectively subservient.

also to prevent these truths from being
point of logical importance, under the
The fact is, that the one class, (in conse-
lation in which they stand to the demon-
sions of geometry,) are comparatively of
that the formal enumeration of them was
choice rather than of necessity; whereas the

other class have unfortunately been raised, by the sceptical controversies of modern times, to a conspicuous rank in the philosophy of the human mind. I have thought it more advisable, therefore, to bestow on the latter an appropriate title of their own; without however going so far, as to reject altogether the phraseology of those who have annexed to the word *axiom* a more enlarged meaning than that which I have usually given to it. Little inconvenience, indeed, can arise from this latitude in the use of the term; provided only it be always confined to those ultimate laws of belief, which, although they form the first elements of human reason, cannot with propriety be ranked among the principles from which any of our scientific conclusions are deduced.

Corresponding to the extension which some late writers have given to *axioms*, is that of the province which they have assigned to *intuition*; a term which has been applied, by Dr. Beattie and others, not only to the power by which we perceive the truth of the axioms of geometry, but to that by which we recognize the authority of the fundamental laws of belief, when we hear them enunciated in language. My only objection to this use of the word is, that it is a departure from common practice; according to which, if I be not mistaken, the proper objects of intuition are propositions analogous to the axioms prefixed to Euclid's Elements. In some other respects, this innovation might perhaps be regarded as an improvement on the very limited and imperfect vocabulary of which we are able to avail ourselves in our present discussions.*

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* According to Locke, we have the knowledge of our own existence by *intuition*; of the existence of God by *demonstration*; and of other things by *sensation*. Book iv. Chap. 9. § 2.

To the class of truths which I have here called *laws of belief*, or *elements of reason*, the title of *principles of common sense* was long ago given by Father Buffier, whose language and doctrine concerning them bears a very striking resemblance to those of some of our later Scotish logicians. This, at least, strikes me as the meaning which these writers *in general* annex to the phrase; although all of them have frequently employed it with a far greater degree of latitude. When thus limited in its acceptation, it is obviously liable, in point of scientific accuracy, to two very strong objections, both of which have been already sufficiently illustrated. The first is, that it applies the appellation of *principles* to laws of belief from which no inference can be deduced; the second, that it refers the origin of these laws to common sense.* Nor is this phraseology more agreeable to popular use than to logical precision. If we were to suppose an individual, whose conduct betrayed a disbelief of his own existence, or of his own identity, or of the reality of surrounding objects,

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This use of the word *intuition* seems to be somewhat arbitrary. The reality of our own existence is a truth which bears as little analogy to the axioms of mathematics, as any other primary truth whatever. If the province of *intuition*, therefore, be extended as far as it has been carried by Locke in the foregoing sentence, it will not be easy to give a good reason why it should not be enlarged a little farther. The words *intuition* and *demonstration*, it must not be forgotten, have, both of them, an etymological reference to the sense of seeing; and when we wish to express, in the strongest terms, the most complete evidence which can be set before the mind, we compare it to the light of noon-day;—in other words, we compare it to what Mr. Locke here attempts to degrade, by calling it *the evidence of sensation*.

* See the preceding part of this section, with respect to the word *principle;* and the Account of Reid's Life, for some remarks on the proper meaning of the phrase *common sense*.

it would by no means amount to an adequate description of his condition to say, that he was destitute of *common sense.* We should at once pronounce him to be destitute of *reason*, and would no longer consider him as a fit subject of discipline or of punishment. The former expression, indeed, would only imply that he was apt to fall into absurdities and improprieties in the common concerns of life. To denominate, therefore, such laws of belief as we have now been considering, *constituent elements of human reason*, while it seems quite unexceptionable in point of technical distinctness, cannot be justly censured as the slightest deviation from our habitual forms of speech. On the same grounds, it may be fairly questioned, whether the word *reason* would not on some occasions, be the best substitute which our language affords for *intuition*, in that enlarged acceptation which has been given to it of late. If not quite so definite and precise as might be wished, it would be at least employed in one of those significations in which it is already familiar to every ear; whereas the meaning of *intuition*, when used for the same purpose, is stretched very far beyond its ordinary limits. And in cases of this sort, where we have to choose between two terms, neither of which is altogether unexceptionable, it will be found much safer to trust to the context for restricting, in the reader's mind, what is too general, than for enlarging what use has accustomed us to interpret in a sense too narrow.

I must add too, in opposition to the high authorities of Dr. Johnson and Dr. Beattie,* that, for many years past,

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* Dr. Johnson's definition of Reason was before quoted. The following is that given by Dr. Beattie.

reason has been very seldom used by philosophical writers, or indeed by correct writers of any description, as synonymous with the power of reasoning. *To appeal to the light of human reason from the reasonings of the schools*, is surely an expression to which no good objection can be made, on the score either of vagueness or of novelty. Nor has the etymological affinity between these two words the slightest tendency to throw any obscurity on the foregoing expression. On the contrary, this affinity may be of use in some of our future arguments, by keeping constantly in view the close and inseparable connexion which will be afterwards shown to exist between the two different intellectual operations which are thus brought into immediate contrast.

The remarks which I have stated in the two preceding sections, comprehend every thing of essential importance which I have to offer on this article of logic. But the space which it has occupied for nearly half a century, in some of the most noted philosophical works which have appeared in Scotland, lays me under the necessity, before entering on a new topic, of introducing in this place, a few critical strictures on the doctrines of my predecessors.

" Reason is used by those who are most accurate in distinguishing, to signify that power of the human mind by which we draw inferences, or by which we are convinced, that a relation belongs to two ideas, on account of our having found that these ideas bear certain relations to other ideas. In a word, it is that faculty which enables us, from relations or ideas that are known, to investigate such as are unknown, and without which we never could proceed in the discovery of truth a single step beyond first principles or intuitive axioms."—*Essay on Truth*, Part I. Chap. i.

SECTION III.

Continuation of the Subject.—Critical Remarks on some late Controversies to which it has given rise.—Of the Appeals which Dr. Reid and some other Modern Writers have made, in their Philosophical Discussions, to Common Sense, as a Criterion of Truth.

I OBSERVED, in a former part of this work, that Dr. Reid acknowledges the Berkeleian system to be a logical consequence of the opinions universally admitted by the learned at the time when Berkeley wrote. In the earlier part of his own life, accordingly, he informs us, that he was actually a convert to the scheme of immaterialism; a scheme which he probably considered as of a perfectly inoffensive tendency, as long as he conceived the existence of the material world to be the only point in dispute. Finding, however, from Mr. Hume's writings, that, along with this paradox, the ideal theory necessarily involved various other consequences of a very different nature, he was led to a careful examination of the data on which it rested; when he had the satisfaction to discover that its only foundation was a *hypothesis*, unsupported by any evidence whatever but the authority of the schools.*

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* It was not, therefore, (as has very generally been imagined by the followers of Berkeley) from any apprehension of danger in his argument against the existence of *matter*, that Reid was induced to call in question

From this important concession of a most impartial and competent judge, it may be assumed as a fact, that till the refutation of the ideal theory in his own "Inquiry into the Human Mind," the partizans of Berkeley's system remained complete masters of the controversial field; and yet, during the long period which intervened, it is well known how little impression that system made on the belief of our soundest philosophers. Many answers to it were attempted, in the meantime, by various authors, both in this country and on the Continent; and by one or other of these, the generality of the learned professed themselves to be convinced of its futility;—the evidence of the conclusion (as in many other cases) supporting the premises, and not the premises the conclusion.* A very

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the ideal theory; but because he thought that Mr. Hume had clearly shown, by turning Berkeley's weapons against himself, that this theory was equally subversive of the existence of *mind*. The ultimate object of Berkeley and of Reid was precisely the same; the one asserting the existence of matter from the very same motive which led the other to deny it.

When I speak of Reid's *asserting the existence of matter*, I do not allude to any new proofs which he has produced of the fact. This he rests on the evidence of sense, as he rests the existence of the mind on the evidence of consciousness. All that he professes to have done is, to show the inconclusiveness of Berkeley's argument against the former, and that of Hume against the latter, by refuting the ideal hypothesis which is the common foundation of both.

* The impotent, though ingenious attempt of Berkeley (not many years after the date of his physical publications) to shake the foundations of the newly-invented method of Fluxions, created, in the public mind, a strong prejudice against him, as a sophistical and paradoxical disputant; and operated as a more powerful antidote to the scheme of immaterialism, than all the reasonings which his contemporaries were able to oppose to it. This unfavourable impression was afterwards not a little confirmed, by the ridicule which he incurred in consequence of his pamphlet on the virtues of Tar-water; a performance, however, of which it is but justice to add, that it con-

curious anecdote, in illustration of this, is mentioned in the life of Dr. Berkeley. After the publication of his book, it appears that he had an interview with Dr. Clarke; in the course of which, Clarke (it is said) discovered a manifest unwillingness to enter into the discussion, and was accused by Berkeley of a want of candour.* The story (which, if I recollect right, rests on the authority of Whiston) has every appearance of authenticity; for as Clarke, in common with his antagonist, regarded the principles of the ideal theory as incontrovertible, it was perfectly impossible for him, with all his acuteness, to detect the flaw to which Berkeley's paradox owed its plausibility. In such circumstances, would it have been unphilosophical in Clarke to have defended himself, by saying: "Your conclusion not only contradicts those perceptions of my senses, the evidence of which I feel to be irresistible; but by annihilating space itself as an external existence, bids defiance to a conviction inseparable from the human understanding; and, therefore, although I cannot point out the precise oversight which has led you astray, there *must* necessarily be some error, either in your original *data*, or in your subsequent reasoning." Or, supposing Clarke to have perceived, as clearly as Reid, that Berkeley's *reasoning* was perfectly unexceptionable, might he not

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tains a great deal more, both of sound philosophy and of choice learning, than could have been expected from the subject.

* Philosophical Essays, Note E.

That Clarke would look upon the Berkeleian theory with more than common feelings of suspicion and alarm, may be easily conceived, when it is recollected that, by denying the independent existence both of *space* and of *time*, it put an end at once to his celebrated argument *a priori*, for the existence have added; "The conclusion which it involves is a demonstration in the form of a *reductio ad absurdum*, of the soundness of the ideal theory, on which the whole of your argument is built?"*

I am far from supposing that Berkeley would have admitted this consideration as decisive of the point in dispute. On the contrary, it appears from his writings, that the scheme of immaterialism was, in his opinion, more agreeable to popular belief, than the received theories of philosophers concerning the independent existence of the external world; nay, that he considered it as one of the many advantages likely to result from the universal adoption of his system, that men would thereby be reduced from paradoxes to *common sense*."

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* I acknowledge, very readily, that the force of this indirect mode of reasoning is essentially different in mathematics, from what it is in the branches of knowledge; for the objects of mathematics (as will afterwards more fully appear) not being *truth*, but systematical connexion and consistency, whenever two contradictory propositions occur, embracing evidently the only possible suppositions on the point in question, if the one can be shown to be incompatible with the definitions or hypotheses on which the science is founded, this may be regarded as perfectly equivalent to a direct proof of the legitimacy of the opposite conclusion. In the other sciences, the force of a *reductio ad absurdum* depends entirely on the maxim, "That truth is always consistent with itself;" a maxim which, however certain, rests evidently on grounds of a more abstract and metaphysical nature than the indirect demonstrations of geometry. It is a maxim, at the same time, to which the most sceptical writers have not been able to refuse their testimony. "Truth (says Mr. Hume himself) *is one thing*, but errors are numberless, and every man has a different one."

The *unity*, or systematical consistency of truth, is a subject which well deserves to be farther prosecuted. It involves many important consequences, of which Mr. Hume does not, from the general spirit of his philosophy, seem to have been sufficiently aware.

The question, however, if not decided by this discussion, would at least have been brought to a short and simple issue; for the paramount authority of the common sense or common reason of mankind being equally recognized by both parties, all that remained for their examination was, whether the belief of existence, or that the non-existence of matter, was sanctioned by this supreme tribunal? For ascertaining this point, nothing more was necessary, than an accurate analysis of the meaning annexed to the word *existence:* which analysis would have at once shown, not only that we are irresistibly led to ascribe to the material world all the independent reality which this word expresses, but that it is from the material world that our first and most satisfactory notions of *existence* are drawn. The mathematical affections of matter (extension and figure) to which the constitution of the mind imperiously forces us to ascribe an existence, not only independent of our perceptions, but necessary and eternal, might more particularly have been pressed upon Berkeley, as proofs how incompatible his notions were with those laws of belief, to which the learned and the unlearned must in common submit.*

But farther, (in order to prevent any cavil about the foregoing illustration,) we shall suppose that Clarke had anticipated Hume in perceiving that the ideal theory went to the annihilation of *mind* as well as of *matter;* and that he had succeeded in proving, to the satisfaction of Berkeley, that nothing existed in the universe but impressions and ideas. Is it possible to imagine, that Berkeley would not immediately have seen and acknowledged, that a theory which led to a conclusion directly contradicted by the evidence of consciousness, ought not, out of respect to ancient authority, to be rashly admitted; and that, in the present instance, it was much more philosophical to argue from the conclusion against the hypothesis, than to argue from the hypothesis in proof of the conclusion? No middle course, it is evident, was left him between such an acknowledgment, and an unqualified acquiescence in those very doctrines which it was the great aim of his system to tear up by the roots.

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* See Note (B.)

The two chief objections which I have heard urged against this mode of defence, are not perfectly consistent with each other. The one represents it as a presumptuous and dangerous innovation in the established rules of philosophical controversy, calculated to stifle entirely a spirit of liberal inquiry: while the other charges its authors with all the meanness and guilt of literary plagiarism. I shall offer a few slight remarks upon each of these accusations.

1. That the doctrine in question is not a new one, nor even the language in which it has been recently stated an innovation in the received phraseology of logical science, has been shown by Dr. Reid, in a collection of very interesting quotations, which may be found in different parts of his Essays on the Intellectual Powers of Man, more particularly in the second chapter of the sixth essay. Nor has this doctrine been generally rejected even by those writers who, in their theories, have departed the farthest from the ordinary opinions of the world. Berkeley has sanctioned it in the most explicit manner, in a passage already quoted from his works, in which he not only attempts the extraordinary task of reconciling the scheme of

naterialism with the common sense of mankind, but al-
es the very circumstance of its conformity to the unso-
sticated judgment of the human race, as a strong argu-
nt in its favour, when contrasted with the paradoxical
trine of the independent existence of matter. The
sst advocates, too, for the necessity of human actions,
e held a similar language; exerting their ingenuity to
w, that there is nothing in this tenet which does not
fectly accord with our internal consciousness, when our
posed feelings of liberty, with all their concomitant
umstances, are accurately analyzed, and duly weigh-
* In this respect, Mr. Hume forms almost a solitary
eption, avowing, with the greatest frankness, the com-
te repugnance between his philosophy and the laws of
ef to which all men are subjected by the constitution
heir nature. "I dine; I play a game at backgammon; I
verse, and am happy with my friends; and when, after
e or four hours of amusement, I would return to these
culations, they appear so cold, so strained, and so ri-
ulous, that I cannot find in my heart to enter into them
' further. Here, then, I find myself absolutely and
essarily determined to live, and talk, and act, like
er people, in the common affairs of life."†

This, I own, appears to me the only argument for the scheme of neces
which deserves a moment's consideration, in the present state of the
roversy: and it is certainly possible to state it in such a form as to give
me degree of plausibility to a superficial inquirer. On this point, how-
, as on many others, our *first* and *third* thoughts will be found perfectly
incide; a more careful and profound examination of the question infal-
r bringing back to their natural impressions, those who reflect on the
ect with candour and with due attention. Having alluded to so very
rtant a controversy, I could not help throwing out this hint here. The
er prosecution of it would be altogether foreign to my present purpose.

Treatise of Human Nature, Vol. I. p. 467.

Even Mr. Hume himself, however, seems at times, to forget his sceptical theories, and sanctions, by his own authority, not only the same logical maxims, but the same mode of expressing them, which has been so severely censured in some of his opponents. "Those (he observes) who have refused the reality of moral distinctions, may be ranked among the disingenuous disputants. The only way of converting an antagonist of this kind, is, to leave him to himself; for, finding that nobody keeps up the controversy with him, 'tis probable he will at last, of himself, from mere weariness, come over to the side of *common sense* and reason."*

To the authorities which have been already produced by Reid and his successors, in vindication of that mode of arguing which is now under our review, I shall beg leave to add another, which, as far as I know, has not yet been remarked by any of them; and which, while it effectually removes from it the imputation of novelty, states, in clear and forcible terms, the grounds of that respect to which it is entitled, even in those cases where it is opposed by logical subtleties which seem to baffle all our powers of reasoning.

"What is it (said some of the ancient sophists) which constitutes what we call little, much, long, broad, small, or great? Do three grains of corn make a heap? The answer must be—No. Do four grains make a heap? You must make the same answer as before.—They continued their interrogations from one grain to another, without end; and if you should happen at last to answer,

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* Inquiry concerning the Principles of Morals.

here is a heap, they pretended your answer was absurd, inasmuch as it supposed, that one single grain makes the difference between what is a heap, and what is not. I might prove, by the same method, that a great drinker is never drunk. Will one drop of wine fuddle him ?—No. Two drops, then ? By no means: neither three nor four. I might thus continue my interrogations from one drop to another: and if, at the end of the 999th drop, you answered he is not fuddled, and at the 1000th he is, I should be entitled to infer, that one single drop of wine makes the difference between being drunk and being sober; which is absurd. If the interrogations went on from bottle to bottle, you could easily mark the difference in question. But he who attacks you with a *sorites*, is at liberty to choose his own weapons : and by making use of the smallest conceivable increments, renders it impossible for you to name a precise point which fixes a sensible limit between being drunk and being sober; between what is little and what is great; between what is enough and what is too much. A man of the world would laugh at these sophistical quibbles, and would *appeal to common sense;* to that degree of knowledge which, in common life, is sufficient to enable us to establish such distinctions. But to this tribunal a professed dialectician was not permitted to resort; he was obliged to answer in form; and if unable to find a solution according to the rules of art, his defeat was unavoidable. Even at this day, an Irish Tutor,* who should harass a Professor at Salamanca with similar subtleties, and should receive no other answer but this,—*common sense, and the general consent of mankind, sufficiently shew that your inferences are false,*—would gain the victory: his antagonist having declined to defend himself with those logical weapons with which the assault had been made.

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* It is remarkable of this ingenious, eloquent, and gallant nation, that it has been for ages distinguished in the universities on the Continent, for its proficiency in the school logic. *Le Sage* (who seems to have had a very just idea of the value of this accomplishment) alludes to this feature in the Irish character, in the account given by Gil Blas of his studies at Oviedo.

Had the foregoing passage been read to the late Dr. Priestley, while he was employed in combating the writings of Reid, Oswald, and Beattie, he would, I apprehend, without hesitation, have supposed it to be the production of one of their disciples. The fact is, it is a translation from Mr. Bayle, an author who was never accused of an undue deference for established opinions, and who was himself undoubtedly one of the most subtile disputants of modern times.*

From this quotation it clearly appears, not only that the *substance* of the doctrine maintained by these philosophers is of a much earlier date than their writings; but that, in adopting the phrase *common sense*, to express that standard or criterion of truth to which they appealed, they did not depart from the language previ-

"Je m'appliquai aussi à la logique, *qui m'apprit à raisonner beaucoup.* J'aimois tant la dispute, que j'arrêtois les passans, connus ou inconnus, pour leur proposer des argumens. Je m'addressois quelquefois à des FIGURES HIBERNOISES qui ne demandoient pas mieux, et il falloit alors nous voir disputer. Quels gestes, quelles grimaces, quelles contorsions! nos yeux étoient pleins de fureur, et nos bouches écumantes. On nous devoit plutot prendre pour des possédés que pour des philosophes."

* See Bayle's Dictionary, article *Chrysippe.* I have availed myself, in the above translation (with a few retrenchments and corrections,) of that which is given in the English Biographical and Critical Dictionary.

ously in use among the least dogmatical of their predecessors.

In the passage just quoted from Bayle, that passion for disputation which, in modern Europe, has so often subjected the plainest truths to the tribunal of metaphysical discussion, is, with great justness, traced to the unlimited influence which the school logic maintained for so many ages over the understandings of the learned. And although, since the period when Bayle wrote, this influence has everywhere most remarkably declined, it has yet left traces behind it, in the habits of thinking and judging prevalent among speculative men, which are but too discernible in all the branches of science connected with the philosophy of the mind. In illustration of this remark, it would be easy to produce a copious list of examples from the literary history of the eighteenth century; but the farther prosecution of the subject here would lead me aside from the conclusions which I have at present in view. I shall therefore content myself with opposing, to the contentious and sceptical spirit bequeathed by the schoolmen to their successors, the following wise and cautious maxims of their master,—maxims which, while they illustrate his anxiety to guard the principles of the demonstrative sciences against the captiousness of sophists, evince the respect which he conceived to be due by the philosopher to the universal reason of the human race.

"Those things are to be regarded as *first truths*, the credit of which is not derived from other truths, but is inherent in themselves. As for *probable* truths, they are such as are admitted by *all* men, or by the *generali-*

ty of men, or by *wise* men; and, among these last, either by all the wise, or by the generality of the wise, or by such of the wise as are of the highest authority."*

The argument from Universal Consent, on which so much stress is laid by many of the ancients, is the same doctrine with the foregoing, under a form somewhat different. It is stated with great simplicity and force by a Platonic philosopher, in the following sentences:

"In such a contest, and tumult, and disagreement, (about other matters of opinion) you may see this one law and language acknowledged by common accord. This the Greek says, and this the barbarian says; and the inhabitant of the continent, and the islander; and the wise, and the unwise."†

It cannot be denied, that against this summary species of logic, when employed without any collateral lights, as an infallible touchstone of philosophical truth, a strong objection immediately occurs. By what test (it may be asked) is a principle of common sense to be distinguished from one of those prejudices to which the whole human race are irresistibly led, in the first instance, by the very constitution of their nature? If no test or criterion of truth can be pointed out but universal consent, may not all those errors which Bacon has called *idola tribus*, claim a right to admission among the incontrovertible axioms of science? And might not the popular cavils against the supposition of the earth's motion, which so long obstructed the progress of the Copernican system, have been legitimately opposed, as a reply of paramount authority, to all the scientific reasonings by which it was supported?

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* Εστι δε αληθῆ μεν και πρωτα, τα μη δὶ ἑτερων, αλλα δὶ ἀυτων εχοντα την πιστιν. Ενδοξα δε, τα δοκουντα πασιν, η τοις πλειστοις, η τοις σοφοις και τουτοις, η τοις πασιν, η τοις πλειστοις, τοις μαλιστα γνωριμοις, και ενδοξοις. —*Aristot*. *Top*. Lib. I. cap. i. (Vol. I. p. 180, ed. Du Val.)

† Εν τοσουτῳ δε πολεμῳ ϗ στασει ϗ διαφωνιᾳ ἱνα ιδοις αν εν παση γῆ ὁμοφωνον νομον ϗ λογον, &c. Ταυταδε ὁ Ἑλλην λεγει, ϗ ὁ Βαρβαρος λεγει, ϗ ὁ ηπειρωτης, ϗ ὁ θαλαττιος, ϗ ὁ σοφος, ϗ ὁ ασοφος.—*Max*. *Tyr*. (speaking of the existence of the Deity,) Dis. I.

"Una in re consensio omnium gentium lex naturæ putanda est."—*Cic*. 1. Tusc.

"Multum dare solemus præsumptioni omnium hominum: Apud nos veritatis argumentum est, aliquid omnibus videri," &c. &c.—*Sen*. Ep. 117.

It is much to be wished that this objection, of which Dr. Reid could not fail to be fully aware, had been more particularly examined and discussed in some of his publications, than he seems to have thought necessary. From different parts of his works, however, various important hints towards a satisfactory answer to it might be easily collected.* At present, I shall only remark, that although *universality of belief* is one of the tests by which (according to him) a principle of common sense is characterized, it is not the only test which he represents as essential. Long before his time, Father Buffier, in his excellent treatise on First Truths, had laid great stress on two other circumstances, as *criteria* to be attended to on such occasions; and although I do not recollect any passage in Reid where they are so explicitly stated, yet the general spirit of his reasonings plainly shows, that he had them constantly in view in all the practical applications of his doctrine. The *first* criterion mentioned by Buffier is, "That the truths assumed as maxims of common sense should be such, that it is impossible for any disputant either to defend or to attack them, but by means of propositions which are neither more manifest nor more certain than the propositions in question." The *second* criterion is, "That their practical influence should extend even to those individuals who affect to dispute their authority."

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* See, in particular, Essays on the Int. Powers, p. 565, et seq. 4to. edit.

To these remarks of Buffier, it may not be altogether superfluous to add, that wherever a prejudice is found to obtain universally among mankind in any stage of society, this prejudice must have some foundation in the general principles of our nature, and must proceed upon some *truth* or fact inaccurately apprehended, or erroneously applied. The suspense of judgment, therefore, which is proper with respect to particular opinions, till they be once fairly examined, can never justify scepticism with respect to the general laws of the human mind. Our belief of the sun's motion is not a conclusion to which we are necessarily led by any such law, but an inference rashly drawn from the preceptions of sense, which do not warrant such an inference. All that we see is, that a relative change of position between us and the sun takes place; and this fact, which is made known to us by our senses, no subsequent discovery of philosophy pretends to disprove. It is not, therefore, the evidence of perception which is overturned by the Copernican system, but a *judgment* or inference of the understanding, of the rashness of which every person must be fully sensible, the moment he is made to reflect with due attention on the circumstances of the case; and the doctrine which this system substitutes instead of our first crude apprehensions on the subject, is founded, not on any process of reasoning *a priori*, but on the demonstrable inconsistency of these apprehensions with the various phenomena which our perceptions present to us. Had Copernicus not only asserted the stability of the Sun, but, with some of the Sophists of old, denied that any such thing as *motion* exists in the universe, his theory would have been precisely analogous to that of the non-existence of matter; and no answer to it could have been thought of more pertinent and philosophical, than that which Plato is said to have given to the same paradox in the mouth of Zeno, by rising up and walking before his eyes.

2. If the foregoing observations be just, they not only illustrate the coincidence between Dr. Reid's general argument against those metaphysical paradoxes which revolt common sense, and the maxims of philosophical discussion previously sanctioned by our soundest reasoners; but they go far, at the same time, to refute that charge of plagiarism in which he has been involved, in common with two other Scotish writers, who have made their stand in opposition to Berkeley and Hume, nearly on the same ground. This charge has been stated in all its force, in the preface to an English translation of Buffier's Premières Vérités, printed at London in the year 1780; and it cannot be denied, that some of the proofs alleged in its support are not without plausibility. But why suppose Reid to have borrowed from this learned Jesuit, a mode of arguing which has been familiar to men in all ages of the world; and to which, long before the publication of Buffier's excellent book, the very same phraseology had been applied by numberless other authors. On this point, the passage already quoted from Bayle is of itself de-

cisive. The truth is, it is a mode of arguing likely to occur to every sincere and enlightened inquirer, when bewildered by sceptical sophistry; and which, during the long interval between the publication of the Berkeleian theory, and that of Reid's Inquiry, was the only tenable post on which the conclusions of the former could be combated. After the length to which the logical consequences of the same principles were subsequently pushed in the *Treatise of Human Nature*, this must have appeared completely manifest to all who were aware of the irresistible force of the argument, as it is there stated; and, in fact, this very ground was taken as early as the year 1751, in a private correspondence with Mr. Hume, by an intimate friend of his own, for whose judgment, both on philosophical and literary subjects, he seems to have felt a peculiar deference.* I mention this, as a proof that the doctrine in question was the natural result of the state of science at the period when Reid appeared; and, consequently, that no argument against his originality in adopting it, can reasonably be founded on its coincidence with the views of any preceding author.

A still more satisfactory reply to the charge of plagiarism may be derived from this consideration, that, in Buffier's Treatise, the doctrine which has furnished the chief ground of accusation is stated with far greater precision and distinctness than in Dr. Reid's *first* publication on the Human Mind; and that, in his subsequent performances, *after* he had perused the writings of Buffier, his phraseology became considerably more guarded and consistent than before.

* See Note (C.)

If this observation be admitted in the case of Dr. Reid, it will be found to apply with still greater force to Dr. Beattie, whose language, in various parts of his book, is so loose and unsettled, as to afford demonstrative proof that it was not from Buffier he derived the idea of his general argument. In confirmation of this, I shall only mention the first chapter of the first part of his Essay, in which he attempts to draw the line between common sense and reason; evidently confounding (as many other authors of high reputation have done) the two very different words, *reason* and *reasoning*. His account of *common sense*, in the following passage, is liable to censure in almost every line; "The term *common sense* hath, in modern times, been used by philosophers, both French and British, to signify that power of the mind which perceives truth, or commands belief, not by progressive argumentation, but by an instantaneous, instinctive, and irresistible impulse; derived neither from education nor from habit, but from nature; acting independently on our will, whenever its object is presented, according to an established law, and *therefore properly called* SENSE,* and acting in a similar manner upon all, or at least upon a great majority of mankind, and therefore properly called COMMON SENSE."*

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* The doctrine of the schoolmen (revived in later times under a form somewhat modified by Locke,) which refers to *sensation* the origin of all our ideas, has given rise to a very unwarrantable extension of the word *sense*, in the writings of modern philosophers. When it was first asserted, that "there is nothing in the intellect which does not come to it through the medium of sense," there cannot be a doubt that, by this last term, were understood exclusively our powers of *external* perception. In process of time, however, it came to be discovered, that there are many ideas which cannot possibly be traced to this source; and which, of consequence, afford undeniable proof that the scholastic account of the origin of our ideas is extremely imperfect. Such was certainly the logical inference to which these discoveries should have led; but, instead of adopting it, philosophers have, from the first, shown a disposition to save, as much as possible, the credit of the

"Reason," on the other hand, (we are told by the same author) "is used by those who are most accurate in distinguishing, to signify that power of the human mind by which we draw inferences, or by which we are convinced that a relation belongs to two ideas, on account of our having found that these ideas bear certain relations to other ideas. In a word, it is that faculty which enables us, from relations or ideas that are known, to investigate such as are unknown; and without which we never could proceed in the discovery of truth a single step beyond first principles or intuitive axioms."† "It is in this last sense (he adds) that we are to use the word *reason* in the course of this inquiry."

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maxims in which they had been educated, by giving to the word *sense* so great a latitude of meaning, as to comprehend all the various sources of our simple ideas, whatever these sources may be. "All the *ideas* (says Dr. Hutcheson) or the materials of our reasoning and judging, are received by some immediate powers of perception, internal or external, which we may call *senses*." Under the title of *internal senses*, accordingly, many writers, particularly of the medical profession, continue to this day to comprehend memory and imagination, and other faculties, both intellectual and active.—(Vid. *Haller*, *Element. Physiologiæ*, Lib. xvii.) Hence also the phrases *moral sense*, *the senses of beauty and harmony*, and many of the other peculiarities of Dr. Hutcheson's language; a mode of speaking which was afterwards carried to a much more blameable excess by Lord Kaimes. Dr. Beattie, in the passage quoted above, has indirectly given his sanction to the same abuse of words; plainly supposing the phrase *common sense*, not only to mean something quite distinct from reason, but something which bears so close an analogy to the powers of external sense, as to be not improperly called by the same name.

* Essay on Truth, p. 40. 2d edit.

† Essay on Truth, pp. 36, 37. 2d edit.

These two passages are severely, and, I think, justly, animadverted on, in the preface to the English translation of Buffier's book, where they are contrasted with the definition of *common sense* given by that profound and orginal philosopher. From this definition it appears, that, far from opposing common sense and reason to each other, he considers them either as the same faculty, or as faculties necessarily and inseparably connected together. "It is a faculty (he says) which appears in all men, or at least in the far greater number of them, when they have arrived at the age of reason, enabling them to form a common and uniform judgment, on subjects essentially connected with the ordinary concerns of life."

That this contrast turns out greatly to the advantage of Buffier,* must, I think, be granted to his very acute

* It is remarkable how little attention the writings of Buffier have attracted in his own country, and how very inadequate to his real eminence has been the rank commonly assigned to him among French philosophers. This has perhaps been partly owing to an unfortunate combination which he thought proper to make of a variety of miscellaneous treatises, of very unequal merit, into a large work, to which he gave the name of a *Course of the Sciences*. Some of these treatises, however, are of great value; particularly that on *First Truths*, which contains (along with some erroneous notions, easily to be accounted for by the period when the author wrote, and the religious society with which he was connected,) many original and important views concerning the foundations of human knowledge, and the first principles of a rational logic. Voltaire, in his catalogue of the illustrious writers who adorned the reign of Louis XIV. is one of the very few French authors who have spoken of Buffier with due respect. "Il y a dans ses traités de métaphysique des morceaux que Locke n'aurait pas désavoués, et c'est le seul jésuite qui ait mis une philosophie raisonnable dans ses ouvrages." Another French philosopher, too, of a very different school, and certainly not disposed to overrate the talents of Buffier, has, in a work published as lately as 1805, candidly acknowledged the lights which he

and intelligent translator. But while I make this concession in favour of his statement, I must be allowed to add, that, in the same proportion in which Dr. Beattie falls short of the clearness and logical accuracy of his predecessor, he ought to stand acquitted, in the opinion of all men of candour, of every suspicion of a dishonourable plagiarism from his writings.

It is the doctrine itself, however, and not the comparative merits of its various abettors, that is likely to interest the generality of philosophical students; and as I have always thought that this has suffered considerably in the public estimation, in consequence of the statement of it given in the passage just quoted from the Essay on Truth, I shall avail myself of the present opportunity to remark, how widely that statement differs from the language, not only of Buffier, but of the author's contemporary and friend, Dr. Reid. This circumstance I think it necessary to mention, as it seems to have been through the medium of Dr. Beattie's Essay, that most English writers have derived their imperfect information concerning Reid's philosophy.

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might have derived from the labours of his predecessor, if he had been acquainted with them at an earlier period of his studies. Condillac, he also observes, might have profited greatly by the same lights, if he had availed himself of their guidance in his inquiries concerning the human understanding. "Du moins est il certain, que pour ma part, je suis fort fâché de ne connoître que depuis très peu de temps ces opinions du Père Buffier; si je les avais vues plutôt énoncées quelque part, elles m'auraient épargné beaucoup de peines et d' hésitations."——"Je regrette beaucoup que Condillac, dans ses profondes et sagaces méditations sur l'intelligence humaine, n'ait pas fait plus d'attention aux idées du Père Buffier," &c. &c.—*Elemens d'Idéologie, par M. Destutt-Tracy*, Tom. III. pp. 136, 137.

"There is a certain degree of *sense* (says this last author, in his Essays on the Intellectual Powers of Man,) which is necessary to our being subjects of law and government, capable of managing our own affairs, and answerable for our conduct to others. This is called *common sense*, because it is common to all men with whom we can transact business."

"The same degree of understanding (he afterwards observes) which makes a man capable of acting with common prudence in life, makes him capable of discerning what is true and what is false, in matters that are self-evident, and which he distinctly apprehends." In a subsequent paragraph, he gives his sanction to a passage from Dr. Bentley, in which *common sense* is expressly used as synonymous with *natural light and reason.*[*]

It is to be regretted, as a circumstance unfavourable to the reception of Dr. Beattie's valuable essay among accurate reasoners, that, in the outset of his discussions, he did not confine himself to some such general explanation of this phrase as is given in the foregoing extracts from Buffier and Reid, without affecting a tone of logical precision in his definitions and distinctions, which, so far from being necessary to his intended argument, were evidently out of place, in a work designed as a popular antidote against the illusions of metaphysical scepticism. The very idea, indeed, of appealing to *common sense*, virtually implies that these words are to be understood in their ordinary acceptation, unrestricted and unmodified by any technical refinements and comments. This part of his essay, accordingly, which is by far the most vulnerable part of it, has been attacked with advantage, not only by the translator of Buffier, but by Sir James Stewart, in a very acute letter published in the last edition of his works.*

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[*] Pages 522, 524, 4to edit. In the following verses of Prior, the word *reason* is employed in an acceptation exactly coincident with the idea which is, *on most occasions*, annexed by Dr. Reid to the phrase *common sense:*

"Note here, Lucretius dares to teach,
(As all our youth may learn from CREECH,)
That eyes were made, but could not view,
Nor hands embrace, nor feet pursue,
But heedless Nature did produce
The members first, and then the use;
What each must act was yet unknown,
Till all was moved by Chance alone.
. . . .
. . . .
Blest for his sake be HUMAN REASON,
Which came at last, tho' late, in season."——*Alma*, Canto I.

While I thus endeavour, however, to distinguish Dr. Reid's definition of *common sense* from that of Dr. Beattie, I am far from considering even the language of the former on this subject, as in every instance unexceptionable; nor do I think it has been a fortunate circumstance (notwithstanding the very high authorities which may be quoted in his vindication,) that he attempted to incorporate so vague and ambiguous a phrase with the appropriate terms of logic. My chief reasons for this opinion I have stated at some length, in an account published a few years ago of Dr. Reid's Life and Writings.*

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* To the honour of Dr. Beattie it must be remarked, that his reply to this letter, (which may be found in Sir James Stewart's works) is written in a strain of forbearance and of good humour, which few authors would have been able to maintain, after being handled so roughly.

One very unlucky consequence has unquestionably resulted from the coincidence of so many writers connected with this northern part of the island, in adopting, about the same period, the same phrase, as a sort of philosophical watch-word;—that, although their views differ widely in various respects, they have in general been classed together as partizans of a new sect, and as mutually responsible for the doctrines of each other. It is easy to perceive the use likely to be made of this accident by an uncandid antagonist.

All of these writers have, in my opinion, been occasionally misled in their speculations, by a want of attention to the distinction between first principles, properly so called, and the fundamental laws of human belief. Buffier himself has fallen into the same error; nor do I know of any one logician, from the time of Aristotle downwards, who has entirely avoided it.

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*In consequence of the ambiguous meaning of this phrase, Dr. Reid sometimes falls into a sort of play on words, which I have often regretted. "If this be philosophy (says he, on one occasion) I renounce her guidance. Let my soul dwell with *common sense*." (*Inquiry into the Human Mind*, Chap. i. Sect. 3. See also Sect. 4. of the same chapter.) And in another passage, after quoting the noted saying of Hobbes, that "when reason is against a man, a man will be against reason;" he adds: "This is equally applicable to *common sense*." (*Essays on the Intellectual Powers*, p. 530. 4to edition.) In both of these instances, and indeed in the general strain of argument which runs through his works, he understands *common sense* in its ordinary acceptation, as synonymous, or very nearly synonymous, with the word *reason*, as it is now most frequently employed. In a few cases, however, he seems to have annexed to the same phrase a technical meaning

The foregoing critical remarks will, I hope, have their use in keeping this distinction more steadily in the view of future inquirers; and in preventing some of the readers of the publications to which they relate, from conceiving a prejudice, in consequence of the looseness of that phraseology which has been accidentally adopted by their authors, against the just and important conclusions which they contain.

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of his own, and has even spoken of this meaning as a thing not generally understood. Thus, after illustrating the different classes of *natural signs*, he adds the following sentence: "It may be observed, that as the first class of natural signs I have mentioned is the foundation of true philosophy, and the second of the fine arts or of taste, so the last is the foundation of *common sense; a part of human nature which hath never been explained.*" *Inquiry*, Chap. v. sect. 3.

See Note (D.)

CHAPTER SECOND.

OF REASONING AND OF DEDUCTIVE EVIDENCE.

SECTION I.

Doubts with respect to Locke's Distinction between the Powers of Intuition and of Reasoning.

ALTHOUGH, in treating of this branch of the Philosophy of the Mind, I have followed the example of preceding writers, so far as to speak of intuition and reasoning as two different faculties of the understanding, I am by no means satisfied that there exists between them that radical distinction which is commonly apprehended. Dr. Beattie, in his Essay on Truth, has attempted to show, that, how closely soever they may in general be connected, yet that this connexion is not necessary; insomuch, that a being may be conceived endued with the one, and at the same time destitute of the other.* Something of this kind, he remarks, takes place in dreams and in madness; in both of which states of the system, the power of reasoning appears occasionally to be retained in no inconsiderable degree, while the power of intuition is suspended or lost. But this doctrine is liable to obvious, and to insurmountable objections; and has plainly taken its rise from the vagueness of the phrase *common sense*, which the author employs through the whole of his argument, as synonymous with the power of *intuition*. Of the indissoluble connexion between this last power and that of reasoning, no other proof is necessary than the following consideration, that, "in every step which reason makes in demonstrative knowledge, there must be intuitive certainty;" a proposition which Locke has excellently illustrated, and which, since his time, has been acquiesced in, so far as I know, by philosophers of all descriptions. From this proposition (which, when properly interpreted, appears to me to be perfectly just) it obviously follows, that the power of reasoning presupposes the power of intuition; and, therefore, the only question about which any doubt can be entertained is, Whether the power of intuition (according to Locke's idea of it) does not also imply that of reasoning? My own opinion is, decidedly, that it does; at least, when combined with the faculty of memory. In examining those processes of thought which conduct the mind by a series of consequences from premises to a conclusion, I can detect no intellectual act whatever, which the joint operation of intuition and of memory does not sufficiently explain.

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* Beattie's Essay, p. 41, 2d edit.

Before, however, proceeding farther in this discussion, it is proper for me to observe, by way of comment on the proposition just quoted from Locke, that, although, "in a complete demonstration, there must be intuitive evidence at every step," it is not to be supposed, that, in every demonstration, all the various intuitive judgments leading to the conclusion are actually presented to our thoughts. In by far the greater number of instances, we trust entirely to judgments resting upon the evidence of memory; by the help of which faculty, we are enabled to connect together the most remote truths, with the very same confidence as if the one were an immediate consequence of the other. Nor does this diminish, in the smallest degree, the satisfaction we feel in following such a train of reasoning. On the contrary, nothing can be more disgusting than a demonstration where even the simplest and most obvious steps are brought forward to view; and where no appeal is made to that stock of previous knowledge which memory has identified with the operations of reason. Still, however, it is true, that it is by a continued chain of intuitive judgments, that the whole science of geometry hangs together; inasmuch as the demonstration of any one proposition virtually includes all the previous demonstrations to which it refers.

Hence it appears, that, in mathematical demonstrations, we have not, at every step, the *immediate* evidence of intuition, but only the evidence of memory. Every demonstration, however, may be resolved into a series of separate judgments, either formed at the moment, or remembered as the results of judgments formed at some preceding period; and it is in the arrangement and concatenation of these different judgments, or *media* of proof, that the inventive and reasoning powers of the mathematician find so noble a field for their exercise.

With respect to these powers of judgment and of reasoning, as they are here combined, it appears to me, that the results of the former may be compared to a collection of separate stones prepared by the chisel for the purposes of the builder; upon each of which stones, while lying on the ground, a person may raise himself, as upon a pedestal, to a small elevation. The same judgments, when combined into a train of reasoning, terminating in a remote conclusion, resemble the formerly unconnected blocks, when converted into the steps of a staircase leading to the summit of a tower, which would be otherwise inaccessible. In the design and execution of this staircase, much skill and invention may be displayed by the architect; but, in order to ascend it, nothing more is necessary than a repetition of the act by which the first step was gained. The fact I conceive to be somewhat analogous, in the relation between the power of judgment, and what logicians call the discursive processes of the understanding.

Mr. Locke's language, in various parts of his Essay, seems to accord with the same opinion. "Every step in reasoning, (he observes) that produces knowledge, has intuitive certainty; *which, when the mind perceives, there is no more required but to remember it*, to make the agreement or disagreement of the ideas, concerning which we inquire, visible and certain. This intuitive perception of the agreement or disagreement of the intermediate ideas, in each step and progression of the demonstration, must also be carried exactly in the mind, and a man must be sure that no part is left out; which, in long deductions, and in the use of many proofs, the memory does not always so readily and exactly retain: therefore it comes to pass, that this is more imperfect than intuitive knowledge, and men embrace often falsehood for demonstrations."*

The same doctrine is stated elsewhere by Mr. Locke, more than once, in terms equally explicit;† and yet his language occasionally favours the supposition, that, in its deductive processes, the mind exhibits some modification of reason essentially distinct from intuition, the account, too, which he has given of their respective provinces, affords evidence that his notions concerning them were not sufficiently precise and settled. "When the mind (says he) perceives the agreement or disagreement of two ideas immediately by themselves, without the intervention of any other, its knowledge may be called intuitive. When it cannot so bring its ideas together, as, by their immediate comparison, and, as it were, juxta-position, or application one to another, to perceive their agreement or disagreement it is fain, by the intervention of other ideas (one or more as it happens) to discover the agreement or disagreement, which it searches; and this is that which we call *reasoning*."‡ According to these definitions, supposing the equality of two lines A and B to be perceived immediately in consequence of their coincidence; the judgment of the mind is intuitive: Supposing A to coincide with B, and B with C; the relation between A and C is perceived by reasoning. Nor is this a hasty inference from Locke's accidental language. That it is perfectly agreeable to the foregoing definitions, as understood by their author, appears from the following passage, which occurs afterwards: "The principal act of *ratiocination* is the finding the agreement or disagreement of two ideas, one with another, by the intervention of a third. As a man, by a yard, finds two houses to be of the same length, which could not be brought together to measure their equality by juxta-position."*

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* B. IV. Chap. ii. § 7. See also B. IV. Chap. xvii. § 15.

† B. IV. Chap. xvii. § 2. B. IV. Chap. xvii. § 4. § 14.

‡ B. IV. Chap. ii. §§ 1. and 2.

This use of the words *intuition* and *reasoning*, is surely somewhat arbitrary. The truth of mathematical axioms has always been supposed to be intuitively obvious; and the first of these, according to Euclid's enumeration, affirms, That if A be equal to B, and B to C, A and C are equal. Admitting, however, Locke's definition to be just, it only tends to confirm what has been already stated with respect to the near affinity, or rather the radical identity, of intuition and of reasoning. When the relation of equality between A and B has once been perceived, A and B are completely identified as the same mathematical quantity; and the two letters may be regarded as synonymous wherever they occur. The faculty, therefore, which perceives the relation between A and C, is the same with the faculty which perceives the relation between A and B, and between B and C.†

In farther confirmation of the same proposition, an appeal might be made to the structure of syllogisms. Is it possible to conceive an understanding so formed as to perceive the truth of the major and of the minor propositions, and yet not to perceive the force of the conclusion? The contrary must appear evident to every person who knows what a syllogism is; or rather, as in this mode of stating an argument, the mind is led from universals to particulars, it must appear evident, that, in the very statement of the major proposition, the truth of the conclusion is presupposed; insomuch, that it was not without good reason Dr. Campbell hazarded the epigrammatic, yet unanswerable remark that, "there is always some radical defect in a syllogism, which is not chargeable with that species of sophism known among logicians by the name of *petitio principii*, or a *begging of the question*."*

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* B. IV. Chap. xvii. § 18.

† Dr. Reid's notions, as well as those of Mr. Locke, seem to have been somewhat unsettled with respect to the precise line which separates intuition from reasoning. That the axioms of geometry are intuitive truths, he has remarked in numberless passages of his works; and yet, in speaking of the application of the syllogistic theory to mathematics, he makes use of the following expression: "The simple *reasoning*, 'A is equal to B, and B to C, therefore A is equal to C,' cannot be brought into any syllogism in figure and mode."—See his *Analysis of Aristotle's Logic*.

The idea which is commonly annexed to *intuition*, as opposed to *reasoning*, turns, I suspect, entirely on the circumstance of *time*. The former, we conceive to be instantaneous; whereas the latter necessarily involves the notion of succession, or of progress. This distinction is sufficiently precise for the ordinary purposes of discourse; nay, it supplies us, on many occasions, with a convenient phraseology: but, in the theory of the mind, it has led to some mistaken conclusions, on which I intend to offer a few remarks in the second part of this section.

So much with respect to the separate provinces of these powers, according to Locke:—a point on which I am, after all, inclined to think, that my own opinion does not differ essentially from his, whatever inferences to the contrary may be drawn from some of his casual expressions. The misapprehensions into which these have contributed to lead various writers of a later date, will, I hope, furnish a sufficient apology for the attempt which I have made, to place the question in a stronger light than he seems to have thought requisite for its illustration.

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* Phil. of Rhet. Vol. I. p. 174.

In some of the foregoing quotations from his Essay, there is another fault of still greater moment; of which, although not immediately connected with the topic now under discussion, it is proper for me to take notice, that I may not have the appearance of acquiescing in a mode of speaking so extremely exceptionable. What I allude to is, the supposition which his language, concerning the powers both of intuition and of reasoning, involves, *that knowledge consists solely in the perception of the agreement or the disagreement of our ideas.* The impropriety of this phraseology has been sufficiently exposed by Dr. Reid, whose animadversions I would beg leave to recommend to the attention of those readers, who, from long habit, may have familiarized their ear to the peculiarities of Locke's philosophical diction. In this place, I think it sufficient for me to add to Dr. Reid's strictures, that Mr. Locke's language has, in the present instance, been suggested to him by the partial view which he took of the subject; his illustrations being chiefly borrowed from mathematics, and the relations about which it is conversant. When applied to these relations, it is undoubtedly possible to annex some sense to such phrases as *comparing ideas,—the juxta-position of ideas:—the perception of the agreements or disagreements of ideas;* but, in most other branches of knowledge, this jargon will be found, on examination, to be altogether unmeaning; and, instead of adding to the precision of our notions, to involve plain facts in technical and scholastic mystery.

This last observation leads me to remark farther, that even when Locke speaks of reasoning in general, he seems, in many cases, to have had a tacit reference, in his own mind, to mathematical demonstration; and the same criticism may be extended to every logical writer whom I know, not excepting Aristotle himself. Perhaps it is chiefly owing to this, that their discussion are so often of very little practical utility: the rules which result from them being wholly superfluous, when applied to mathematics; and, when extended to other branches of knowledge, being unsusceptible of any precise, or even intelligible interpretation.

SECTION I.

II.

Conclusions obtained by a Process of Deduction often mistaken for Intuitive Judgments.

It has been frequently remarked, that the justest and most efficient understandings are often possessed by men who are incapable of stating to others, or even to themselves, the grounds on which they proceed in forming their decisions. In some instances, I have been disposed to ascribe this to the faults of early education;

but, in other cases, I am persuaded, that it was the effect of active and imperious habits in quickening the evanescent processes of thought, so as to render them untraceable by the memory; and to give the appearance of *intuition* to what was in fact the result of a train of reasoning so rapid as to escape notice. This I conceive to be the true theory of what is generally called *common sense*, in opposition to book-learning; and it serves to account for the use which has been made of this phrase, by various writers, as synonymous with intuition.

These seemingly instantaneous judgments have always appeared to me as entitled to a greater share of our confidence than many of our more deliberate conclusions; inasmuch as they have been *forced*, as it were, on the mind, by the lessons of long experience; and are as little liable to be biassed by temper or passion, as the estimates we form of the distances of visible objects. They constitute, indeed, to those who are habitually engaged in the busy scenes of life, a sort of peculiar *faculty*, analogous, both in its origin and in its use, to the *coup d'oeil* of the military engineer, or to the quick and sure tact of the medical practitioner, in marking the diagnostics of disease.

For this reason, I look upon the distinction between our intuitive and deductive judgments as, in many cases, merely an object of theoretical curiosity. In those simple conclusions which all men are impelled to form by the necessities of their nature, and in which we find an uniformity not less constant than in the acquired perceptions of sight, it is of as little consequence to the logician to spend his time in efforts to retrace the first steps of the infant understanding, as it would be to the sailor or the sportsman to study, with a view to the improvement of his eye, the Berkeleian theory of vision. In both instances, the original faculty and the acquired judgment are equally entitled to be considered as the work of Nature; and in both instances we find it equally impossible to shake off her authority. It is no wonder, therefore, that, in popular language, such words as *common sense* and *reason* should be used with a considerable degree of latitude; nor is it of much importance to the philosopher to aim at extreme nicety in defining their province, where all mankind, whether wise or ignorant, think and speak alike.

In some rare anomalous cases, a rapidity of judgment in the more complicated concerns of life, appears in individuals who have had so few opportunities of profiting by experience, that it seems, on a superficial view, to be the immediate gift of heaven. But, in all such instances (although a great deal must undoubtedly be ascribed to an inexplicable aptitude or predisposition of the intellectual powers,) we may be perfectly assured, that every judgment of the understanding is preceded by a process of reasoning or deduction, or whether the individual himself be able to recollect it or not. Of this I can no more doubt, than I could bring myself to believe that the Arithmetical Prodigy, who has, of late, so justly attracted the attention of the curious, is able to extract square and cube roots by an instinctive and instantaneous perception, because the process of mental calculation, by which he is led to the result, eludes all his efforts to recover it.*

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* See Note (E.)

It is remarked by Mr. Hume, with respect to the elocution of Oliver Cromwell, that "it was always confused, embarrassed, and unintelligible."—"The great defect, however, (he adds) in Oliver's speeches consisted, not in his want of elocution, but in his want of ideas; the sagacity of his actions, and the absurdity of his discourse, forming the most prodigious contrast that ever was known." —"In the great variety of human geniuses (says the same historian, upon a different occasion) there are some which, though they see their object clearly and distinctly in general; yet, when they come to unfold its parts by discourse or writing, loose that luminous conception which they had before attained. All accounts agree in ascribing to Cromwell, a tiresome, dark, unintelligible elocution, even when he had no intention to disguise his meaning: Yet, no man's actions were ever, in such a variety of difficult incidents, more decisive and judicious."

The case here described may be considered as an *extreme* one; but every person of common observation must recollect facts somewhat analogous, which have fallen under his own notice. Indeed, it is no more than we should expect *à priori*, to meet with, in every individual whose early habits have trained him more to the active business of the world, than to those pursuits which prepare the mind for communicating to others its ideas and feelings, with clearness and effect.

An anecdote which I heard, many years ago, of a late very eminent Judge (Lord Mansfield) has often recurred to my memory, while reflecting on these apparent inconsistencies of intellectual character. A friend of his, who possessed excellent natural talents, but who had been prevented, by his professional duties as a naval officer, from bestowing on them all the cultivation of which they were susceptible, having been recently appointed to the government of Jamaica, happened to express some doubts of his competency to preside in the Court of Chancery. Lord Mansfield assured him that he would find the difficulty not so great as he apprehended. "Trust (he said) to your own good sense in forming your opinions; but beware of attempting to state the grounds of your judgments. The judgment will probably be right;—the argument will infallibly be wrong."

From what has been said, it seems to follow, that although a man should happen to reason ill in support of a sound conclusion, we are by no means entitled to infer with confidence, that he judged right merely by accident. It is far from being impossible that he may have committed some mistake in stating to others (perhaps in retracing to himself) the grounds upon which his judgment was really founded. Indeed, this *must* be the case, wherever a shrewd understanding in business is united with an incapacity for clear and luminous reasoning; and something of the same sort is incident, more or less, to all men (more particularly to men of quick parts) when they make an attempt, in discussions concerning human affairs, to remount to *first principles*. It may be added, that in the old, this correctness of judgment often remains, in a surprising degree, long after the discursive or argumentative power would seem, from some decay of attention, or confusion in the succession of ideas, to have been sensibly impaired by age or by disease.

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In consequence of these views, as well as of various others, foreign to the present subject, I am led to entertain great doubts about the solidity of a very specious doctrine laid down by Condorcet, in his "Essay on the Application of Mathematical Analysis to the Probabilities of Decisions resting upon the votes of a Majority." "It is extremely possible, (he observes) that the decision which unites in its favour the greatest number of suffrages, may comprehend a variety of propositions, some of which, if stated apart, would have had a plurality of voices against them; and, as the truth of a system of propositions, supposes that each of the propositions composing it is true, the probability of the system can be rigorously deduced only from an examination of the probability of each proposition separately considered."*

When this theory is applied to a court of law, it is well known to involve one of the nicest questions in practical jurisprudence; and, in that light, I do not presume to have formed any opinion with respect to it. It may be doubted, perhaps, if it be not one of those problems, the solution of which, in particular instances, is more safely entrusted to discretionary judgment, than to the rigorous application of any technical rule founded on abstract principles. I have introduced the quotation here, merely on account of the proof which it has been supposed to afford, that the seeming diversities of human belief fall, in general, greatly short of the reality. On this point the considerations already stated, strongly incline me to entertain an idea directly contrary. My reasons for thinking so may be easily collected from the tenor of the preceding remarks.

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* Essai sur l'Application de l'Analyse à la probabilité des Décisions rendue à la pluralité des Voix. *Disc. Prel.* pp 46, 47.

Some of the expressions in the above quotation are not agreeable to the idiom of our language; but I did not think myself entitled to depart from the phraseology of the original. The meaning is sufficiently obvious.

It is time, however, to proceed to the examination of those discursive processes, the different steps of which admit of being distinctly stated and enunciated in the form of logical arguments; and which, in consequence of this circumstance, furnish more certain and palpable data for our speculations. I begin with some remarks on the Power of General Reasoning; for the exercise of which, (as I formerly endeavoured to show) the use of language, as an instrument of thought, is indispensably requisite.

SECTION II.

Of General Reasoning.

I.

Illustrations of some Remarks formerly stated in treating of Abstraction.

I SHOULD scarcely have thought it necessary to resume the consideration of Abstraction here, if I had not neglected, in my first volume, to examine the force of an objection to Berkeley's doctrine concerning abstract general ideas, on which great stress is laid by Dr. Reid, in his Essays on the Intellectual Powers of Man; and which some late writers seem to have considered as not less conclusive against the view of the question which I have taken. Of this objection I was aware from the first; but was unwilling, by replying to it in form, to lengthen a discussion which savoured so much of the schools; more especially, as I conceived that I had guarded my own argument from any such attack, by the cautious terms in which I had expressed it. Having since had reason to believe that I was precipitate in forming this judgment, and that Reid's strictures on Berkeley's theory of General Signs have produced a deeper impression than I had expected,* I shall endeavour to obviate them, at least as far as they apply to myself, before entering on any new speculations concerning our reasoning powers; and shall, at the same time, introduce some occasional illustrations of the principles which I formerly endeavoured to establish.

To prevent the possibility of misrepresentation, I state Dr. Reid's objection in his own words.

"Berkeley, in his reasoning against abstract general ideas, seems unwillingly or unwaringly to grant all that is necessary to support abstract and general conceptions.

"A man (says Berkeley) may consider a figure merely as triangular, without attending to the particular qualities of the angles, or relations of the sides. So far he may abstract. But this will never prove that he can frame an abstract general inconsistent idea of a triangle."

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* See a book entitled, Elements of Intellectual Philosophy, by the late learned and justly regretted Mr. Scott, of King's College, Aberdeen, p. 118. et seq. (Edinburgh, 1805.) I have not thought it necessary to reply to Mr. Scott's own reasonings, which do not appear to me to throw much new light on the question; but I thought it right to refer to them here, that the reader may, if he pleases, have an opportunity of judging for himself.

"Upon this passage Dr. Reid makes the following remark: *If a man may consider a figure merely as triangular, he must have some conception of this object of his consideration; for no man can consider a thing which he does not conceive. He has a conception, therefore, of a triangular figure, merely as such. I know no more that is meant by an abstract general conception of a triangle.*"

"He that considers a figure merely as triangular (continues the same author) must understand what is meant by the word triangular. If to the conception he joins to this word, he adds any particular quality of angles or relation of sides, he misunderstands it, and does not consider the figure merely as triangular. Whence I think it is evident, that he who considers a figure merely as triangular, must have the conception of a triangle, abstracting from any quality of angles or relations of sides."*

For what appears to myself to be a satisfactory answer to this reasoning, I have only to refer to the first volume of these Elements. The remarks to which I allude are to be found in the third section of chapter fourth;† and I must beg leave to recommend them to the attention of my readers as a necessary preparation for the following discussion.

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* Reid's Intellectual Powers, p. 483, 4to edit.

† P. 195. 3d edit.

In the farther prosecution of the same argument, Dr. Reid lays hold of an acknowledgment which Berkeley has made, "That we may consider *Peter* so far forth as man, or so far forth as animal, inasmuch as all that is perceived is not considered."—"It may here (says Reid) be observed, that he who considers *Peter* so far forth as man, or so far forth as animal, must *conceive* the meaning of those abstract general words *man* and *animal*; and he who *conceives* the meaning of them, has an abstract general conception."

According to the definition of the word *conception*, which I have given in treating of that faculty of the mind, a *general conception* is an obvious impossibility. But, as Dr. Reid has chosen to annex a more extensive meaning to the term than seems to me consistent with precision, I would be far from being understood to object to his conclusion, *merely* because it is inconsistent with an arbitrary definition of my own. Let us consider, therefore, how far his doctrine is consistent with itself; or rather, since both parties are evidently so nearly agreed about the principal fact, which of the two have adopted the more perspicuous and philosophical mode of stating it.

In the first place, then, let it be remembered as a thing admitted on both sides, "that we have a power of *reasoning* concerning a figure considered merely as triangular, without attending to the particular qualities of the angles, or relations of the sides;" and also, that "we may reason concerning *Peter* or *John*, considered so far forth as *man*, or so far forth as *animal*." About these facts there is but one opinion; and the only question is, Whether it throws additional light on the subject, to tell us, in scholastic language, that "we are enabled to carry on these general reasonings, in consequence of the power which the mind has of forming abstract general conceptions." To myself it appears, that this last statement (even on the supposition that the word *conception* is to be understood agreeably to Dr. Reid's own explanation,) can serve no other purpose than that of involving a plain and simple truth in obscurity and mystery. If it be used in the sense in which I have invariably employed it in this work, the proposition is altogether absurd and incomprehensible.

For the more complete illustration of this point, I must here recur to a distinction formerly made between the abstractions which are subservient to reasoning, and those which are subservient to imagination. "In every instance in which imagination is employed in forming new wholes, by decompounding and combining the perceptions of sense, it is evidently necessary that the poet or the painter should be able to *state* or *represent* to himself the circumstances abstracted, as separate objects of conception. But this is by no means requisite in every case in which abstraction is subservient to the power of reasoning; for it frequently happens, that we can reason concerning the quality or property of an object abstracted from the rest, while, at the same time, we find it impossible to conceive it separately. Thus, I can reason concerning extension and figure, without any reference to colour, although it may be doubted, if a person possessed of sight can make extension and figure steady objects of conception, without connecting with them the idea of one colour or another. Nor is this always owing (as it is in the instance just mentioned) merely to the association of ideas; for there are cases, in which we can *reason* concerning things separately, which it is impossible for us to suppose any mind so constituted as to conceive apart. Thus we can reason concerning length, abstracted from any other dimension; although, surely, no understanding can make length, without breadth, an object of conception."* In like manner, while I am studying Euclid's demonstration of the equality of the three angles of a triangle to two right angles, I find no difficulty in following his train of reasoning, although it has no reference to the specific *size* or to the specific *form* of the diagram before me. I *abstract*, therefore, in this instance, from both of these circumstances presented to my senses by the immediate objects of my perceptions; and yet it is manifestly impracticable for me either to delineate on paper, or to conceive in the mind, such a figure as shall not include the circumstances from which I abstract, as well as those on which the demonstration hinges.

In order to form a precise notion of the manner in which this process of the mind is carried on, it is necessary to attend to the close and inseparable connexion which exists between the faculty of general reasoning, and the use of artificial language. It is in consequence of the aids which *this* lends to our natural faculties, that we are furnished with a class of signs, expressive of all the circumstances which we wish our reasonings to comprehend; and, at the same time, exclusive of all those which we wish to leave out of consideration. The word *triangle*, for instance, when used without any additional epithet, confines the attention to the *three* angles and *three* sides of the figure before us; and reminds us, as we proceed, that no step of our deduction is to turn on any of the specific varieties which that figure may exhibit. The notion, however, which we annex to the word *triangle*, while we are reading the demonstration, is not the less a *particular* notion, that this word, from its partial or abstracted import, is equally applicable to an infinite variety of other individuals. *

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* Vol. I. pp. 157, 158, 3d edit.

These observations lead, in my opinion, to so easy an explanation of the transition from *particular* to *general reasoning*, that I shall make no apology for prosecuting the subject a little farther, before leaving this branch of my argument.

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* "By this imposition of names, some of larger, some of stricter signification, we turn the reckoning of the consequences of things imagined in the mind, into a reckoning of the consequences of appellations. For example, a man that hath no use of speech at all (such as is born and remains perfectly deaf and dumb) if he set before his eyes a triangle, and by it two right angles (such as are the corners of a square figure) he may by meditation compare and find, that the three angles of that triangle, are equal to those right angles that stand by it. But if another triangle be shown him, different in shape from the former, he cannot know, without a new labour, whether the three angles of that also be equal to the same. But he that hath the use of words, when he observes that such equality was consequent, not to the length of the sides, nor to any particular thing in this triangle; but only to this, that the sides were straight, and the angles three; and that that was all for which he named it a triangle; will boldly conclude universally, that such equality of angles is in all triangles whatsoever; and register his invention in these general terms, *Every triangle hath its three angles equal to two right angles.* And thus the consequence found in one particular, comes to be registered and remembered as an universal rule; and discharges our mental reckoning of time and place; and delivers us from all labour of the mind, saving the first; and makes that which was found true *here*, and *now*, to be true in *all times* and *places*."—*Hobbes*, *Of Man*, Part I. Chap. iv.

It will not, I apprehend, be denied, that when a learner first enters on the study of geometry, he considers the diagrams before him as individual objects, and as individual objects alone. In reading, for example, the demonstration just referred to, of the equality of the three angles of every triangle to two right angles, he thinks only of the triangle which is presented to him on the margin of the page. Nay, so completely does this particular figure engross his attention, that it is not without some difficulty he, in the first instance, transfers the demonstration to another triangle whose form is very different, or even to the same triangle placed in an inverted position. It is in order to correct this natural bias of the mind, that a judicious teacher, after satisfying himself that the student comprehends perfectly the force of the demonstration, as applicable to the particular triangle which Euclid has selected, is led to vary the diagram in different ways, with a view to show him, that the very same demonstration expressed in the very same form of words, is equally applicable to them all. In this manner he comes, by slow degrees, to comprehend the nature of general reasoning, establishing insensibly in his mind this fundamental logical principle, that when the enunciation of a mathematical proposition involves only a certain portion of the attributes of the diagram which is employed to illustrate it, the same proposition must hold true of any other diagram involving the same attributes, how much soever distinguished from it by other specific peculiarities.*

* In order to impress the mind still more forcibly with the same conviction, some have supposed that it might be useful, in an elementary work, such as that of Euclid, to omit the diagrams altogether, leaving the student to delineate them for himself, agreeably to the terms of the enunciation and of

Of all the generalizations in geometry, there are none into which the mind enters so easily, as those which relate to diversities in point of *size* or *magnitude*. Even in reading the very first demonstrations of Euclid, the learner almost immediately sees, that the *scale* on which the diagram is constructed, is as completely out of the question as the *breadth* or the *colour* of the lines which it presents to his external senses. The demonstration,

the construction. And were the study of geometry to be regarded merely as subservient to that of logic, much might be alleged in confirmation of this idea. Where, however, it is the main purpose of the teacher (as almost always happens) to familiarize the mind of his pupil with the fundamental principles of the science, as a preparation for the study of physics, and of the other parts of mixed mathematics, it cannot be denied, that such a practice would be far less favourable to the memory, than the plan which Euclid has adopted, of annexing to each theorem an appropriate diagram, with which the general truth comes very soon to be strongly associated. Nor is this circumstance found to be attended in practice with the inconvenience it may seem to threaten; inasmuch as the student, without any reflection whatever on logical principles, generalizes the particular example, according to the different cases which may occur, as easily and unconsciously as he could have applied to these cases the general enunciation.

The same remark may be extended to the other departments of our knowledge; in all of which it will be found useful to associate with every important general conclusion some particular example or illustration, calculated, as much as possible, to present an impressive image to the power of conception. By this means, while the example gives us a firmer hold, and a readier command of the general theorem, the theorem, in its turn, serves to correct the errors into which the judgment might be led by the specific peculiarities of the example. Hence, by the way, a strong argument in favour of the practice recommended by Bacon, of connecting *emblems* with *prænotions*, as the most powerful of all *adminicles* to the faculty of memory; and hence the aid which this faculty may be expected to receive, in point of promptitude, if not of correctness, from a lively imagination. Nor is it the least advantage of this practice, that it supplies us at all times with ready and apposite illustrations to facilitate the communication of our general conclusions to others. But the prosecution of these hints would lead me too far astray from the subject of this section.

for example, of the fourth proposition, is transferred, without any conscious process of reflection, from the two triangles on the margin of the page, to those comparatively large ones which a public teacher exhibits on his board or slate to a hundred spectators. I have frequently, however, observed in beginners, while employed in copying such elementary diagrams, a disposition to make the copy, as nearly as possible, both in size and figure, a *fac simile* of the original.

The generalizations which extend to varieties of *form* and of *position*, are accomplished much more slowly; and for this obvious reason, that these varieties are more strongly marked and discriminated from one another, as objects of vision and of conception. How difficult (comparatively speaking) in such instances, the generalizing process is, appears manifestly from the embarrassment which students experience, in applying the fourth proposition to the demonstration of the fifth. The inverted position, and the partial coincidence of the two little triangles below the base, seem to render their mutual relation so different from that of the two separate triangles which had been previously familiarized to the eye, that it is not surprising this step of the reasoning should be followed, by the mere novice, with some degree of doubt and hesitation. Indeed, where nothing of this sort is manifested, I should be more inclined to ascribe the apparent quickness of his apprehension to a retentive memory, seconded by implicit faith in his instructer; than to regard it as a promising symptom of mathematical genius.

Another, and perhaps a better illustration of that natural logic which is exemplified in the generalization of mathematical reasonings, may be derived from those instances where the same demonstration applies, in the same words, to what are called, in geometry, the different *cases* of a proposition. In the commencement of our studies, we read the demonstration over and over, applying it successively to the different diagrams; and it is not without some wonder we discover, that it is equally adapted to them all. In process of time, we learn that this labour is superfluous; and if we find it satisfactory in one of the *cases*, can anticipate with confidence the justness of the general conclusion, or the modifications which will be necessary to accommodate it to the different forms of which the hypothesis may admit.

The algebraical *calculus*, however, when applied to geometry, places the foregoing doctrine in a point of view still more striking; "representing (to borrow the words of Dr. Halley) all the possible cases of a problem at one view; and often in one general theorem comprehending whole sciences: which deduced at length into propositions, and demonstrated after the manner of the ancients, might well become the subject of large treatises."* Of this remark, Halley gives an instance in a *formula*, which, when he first published it, was justly regarded "as a notable instance of the great use and comprehensiveness of algebraic solutions." I allude to his formula for finding universally the foci of optic lenses; an example which I purposely select, as it cannot fail to be familiarly known to all who have the slightest tincture of mathematical and physical science.

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* Philos. Transact. No. 206. Miscell. Cur. Vol. I. p. 348.

In such instances as these, it will not surely be supposed, that while we read the geometrical demonstration, or follow the successive steps of the algebraical process, our *general conceptions* embrace all the various possible cases to which our reasonings extend. So very different is the fact, that the wide grasp of the conclusion is discovered only by a sort of subsequent *induction;* and, till habit has familiarized us with similar discoveries, they never fail to be attended with a certain degree of unexpected delight. Dr. Halley seems to have felt this strongly when the optical *formula* already mentioned first presented itself to his mind.

In the foregoing remarks, I have borrowed my examples from mathematics, because, at the period of life when we enter on this study, the mind has arrived at a sufficient degree of maturity to be able to reflect accurately on every step of its own progress; whereas, in those general conclusions to which we have been habituated from childhood, it is quite impossible for us to ascertain, by any direct examination, what the processes of thought were, which originally led us to adopt them. In this point of view, the first doubtful and unassured steps of the young geometer, present to the logician a peculiarly interesting and instructive class of phenomena, for illustrating the growth and developement of our reasoning powers. The true theory, more especially of *general reasoning*, may be here distinctly traced by every attentive observer; and may hence be confidently applied (under due limitations) to all the other departments of human knowledge.*

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* The view of general reasoning which is given above, appears to myself to afford (without any comment) a satisfactory answer to the follow-

From what has been now said, it would appear, that, in order to arrive at a general conclusion in mathematics,

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ing argument of the late worthy and learned Dr. Price: "That the universality consists in the *idea*, and not merely in the *name*, as used to signify a number of particulars, *resembling* that which is the immediate object of reflection, is plain; because, was the idea to which the name answers, and which it recalls into the mind, only a particular one, we could not know to what other ideas to apply it, or what particular objects had the resemblance necessary to bring them within the meaning of the name. A person, in reading over a mathematical demonstration, certainly is conscious that it relates to somewhat else, than just that precise figure presented to him in the diagram. But if he knows not what else, of what use can the demonstration be to him? How is his knowledge enlarged by it? Or how shall he know afterwards to what to apply it?"

In a note upon this passage, Dr. Price observes, that, "according to Dr. Cudworth, abstract ideas are implied in *the cognoscitive power of the mind; which, he says, contains in itself virtually (as the future plant or tree is contained in the seed) general notions or exemplars of all things, which are exerted by it, or unfold and discover themselves, as occasions invite, and proper circumstances occur.*" "This no doubt (Dr. Price adds) many will very freely condemn as whimsical and extravagant. I have, I own, a different opinion of it; but yet I should not care to be obliged to defend it."—*Review of the Principal Questions in Morals*, pp. 38, 39, 2d edit.

For my own part, I have no scruple to say, that I consider this fancy of Cudworth as not only *whimsical and extravagant*, but as altogether unintelligible; and yet it appears to me, that some confused analogy of the same sort must exist in the mind of every person who imagines that he has the power of forming *general conceptions* without the intermediation of language.

In the continuation of the same note, Dr. Price seems disposed to sanction another remark of Dr. Cudworth: in which *he pronounces the opinion of the nominalists to be so ridiculous and false, as to deserve no confutation.* I suspect that when Dr. Cudworth wrote this splenetic and oracular sentence, he was out of humour with some argument of Hobbes, which he found himself unable to answer. It is not a little remarkable, that the doctrine which he here treats with so great contempt, should, with a very few exceptions, have united the suffrages of all the soundest philosophers of the eighteenth century.

and the same observation holds with respect to other sciences two different processes of reasoning are necessary. The one is *the demonstration* of the proposition in question: in studying which we certainly think of nothing but the individual diagram before us. The other is, the train of thought by which we transfer the particular conclusion to which we have been thus led, to any other diagram to which the same enunciation is equally applicable. As this last train of thought is, in all cases, essentially the same, we insensibly cease to repeat it when the occasion for employing it occurs, till we come at length, without any reflection, to generalize our particular conclusion, the moment it is formed; or, in other words, to consider it as a proposition comprehending an indefinite variety of particular truths. When this habit is established, we are apt to imagine,—forgetting the slow steps by which the habit was acquired,—that the general conclusion is an *immediate* inference from a general demonstration; and that, although there was only one particular diagram present to our external senses, we must have been aware, at every step, that our thoughts were really conversant, *not* about this diagram, but about *general ideas*, or, in Dr. Reid's language, *general conceptions*. Hence the familiar use among logicians of these scholastic and mysterious phrases, which, whatever attempts may be made to interpret them in a manner not altogether inconsistent with good sense, have unquestionably the effect of keeping out of view the real procedure of the human mind in the generalization of its knowledge.

Dr. Reid seems to be of opinion, that it is by the power of forming *general conceptions*, that man is distinguished from the brutes; for he observes, that "Berkeley's system goes to destroy the barrier between the rational and animal natures." I must own I do not perceive the justness of this remark, at least in its application to the system of the nominalists, as I have endeavoured to explain and to limit it in the course of this work. On the contrary, it appears to me, that the account which has been just given of *general reasoning*, by ascribing to a process of *logical deduction* (presupposing the previous exercise of *abstraction* or *analysis*) what Dr. Reid attempts to explain by the scholastic, and not very intelligible phrase of *general conceptions*, places the distinction between man and brutes in a far clearer and stronger light than that in which philosophers have been accustomed to view it. That it is to the exclusive possession of the faculty of *abstraction*, and of the other powers subservient to the use of general signs, that our species is chiefly indebted for its superiority over the other animals, I shall afterwards endeavour to show.

It still remains for me to examine an attempt which Dr. Reid has made, to convict Berkeley of *an inconsistency*, in the statement of his argument against abstract general ideas. "Let us now consider (says he) the Bishop's notion of generalizing. An idea (he tells us) which, considered in itself, is particular, becomes general, by being made to represent or stand for all other particular ideas of the same sort. To make this plain by an example: Suppose (says Berkeley) a geometrician is demonstrating the method of cutting a line into two equal parts. He draws, for instance, a black line of an inch in length. This, which is in itself a particular line, is nevertheless, with regard to its signification, general, since, as it is there used, it represents all particular lines whatsoever, so that what is demonstrated of it, is demonstrated of all lines, or, in other words, of a line in general. And as that particular line becomes general by being made a sign, so the name *line*, which, taken absolutely, is particular, by being a sign, is made general.

" Here (continues Dr. Reid) I observe, that when a particular idea is made a sign to represent and stand for *all of a sort*, this supposes a distinction of things into sorts or species. To be of *a sort*, implies having those attributes which characterize the sort, and are common to all the individuals that belong to it. There cannot therefore be *a sort*, without general attributes; nor can there be any conception of a sort without a conception of those general attributes which distinguish it. The conception of *a sort*, therefore, is an abstract general conception.

" The particular idea cannot surely be made a sign of a thing of which we have no conception. I do not say, that you must have *an idea* of the sort; but surely you ought to *understand* or *conceive* what it means when you make a particular idea a representative of it; otherwise your particular idea represents you know not what."*

Although I do not consider myself as called upon to defend all the expressions which Berkeley may have employed in support of his opinion on this question, I must take the liberty of remarking, that, in the present instance, he appears to me to have been treated with an undue severity. By *ideas of the same sort*, it is plain he meant nothing more than *things called by the same name*, and, consequently, (if our illustrations are to be borrowed from mathematics) *comprehended under the terms of the same definition*. In such cases, the individuals, thus classed together, are completely *identified* as subjects of reasoning; insomuch, that what is proved with respect to one individual, must hold equally true of all the others. As it is an axiom in geometry, that things which are equal to one and the same thing, are equal to one another; so it may be stated as a maxim in logic, that whatever things have the same *name* applied to them, in consequence of their being comprehended in the terms of the same definition, may all be considered as *the same identical subject*, in every case where that definition is the principle on which our reasoning proceeds. In reasoning, accordingly, concerning any *sort* or *species* of things, our thoughts have no occasion to wander from the individual *sign* or *representative* to which the attention happens to be directed, or to attempt the fruitless task of grasping at those specific varieties which are avowedly excluded from the number of our premises. As every conclusion which is logically deduced from the definition must, of necessity, hold equally true of all the individuals to which the common name is applicable, these individuals are regarded merely as so many *units*, which go to the composition of the multitude comprehended under the collective or generic term. Nor has the power of conception any thing more to do in the business, than when we think of the *units* expressed by a particular number in an arithmetical computation.

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* Pages 484, 485.

The word *sort* is evidently transferred to our intellectual arrangements, from those distributions of material objects into separate heaps or collections which the common sense of mankind universally leads them to make for the sake of the memory; or (which is perhaps nearly the same thing) with a view to the pleasure arising from the perception of order. A familiar instance of this presents itself in the shelves, and drawers, and parcels, to which every shop-keeper has recourse for assorting, according to their respective denominations and prices, the various articles which compose his stock of goods. In one parcel (for example) he collects and incloses under one common *envelope*, all his *gloves* of a particular size and quality; in another, all his *gloves* of a different size and quality; and, in like manner, he proceeds with the stockings, shoes, hats, and the various other commodities with which his warehouse is filled. By this means, the attention of his shop-boy, instead of being bewildered among an infinitude of particulars, is confined to *parcels* or *assortments* of particulars; of each of which parcels a distinct idea may be obtained from an examination of any one of the individuals contained in it. These individuals, therefore, are in his apprehension, nothing more than so many *units* in a multitude, any one of which units is perfectly equivalent to any other; while, at the same time, the parcels themselves, notwithstanding the multitude of units of which they are made up, distract his attention, and burden his memory as little, as if they were individual articles. The truth is, that they become to his mind *individual objects of thought*, like a *box* of counters, or *rouleau* of guineas, or any of the other material aggregates with which his senses are conversant; or, to take an example still more apposite to our present purpose, like the phrases *one* thousand, or *one* million, when considered merely as simple *units* entering into the composition of a numerical sum.

The task which I have here supposed the tradesman to perform, in order to facilitate the work of his shop-boy, is exactly analogous, in its effect, to the aid which is furnished to the infant understanding by the structure of its mother-tongue; the generic words which abound in language assorting, and (if I may use the expression) *packing up*, under a comparatively small number of comprehensive terms, the multifarious objects of human knowledge.* In consequence of the generic terms to which, in civilized society, the mind is early familiarized, the vast multiplicity of things which compose the furniture of this globe are presented to it, *not* as they occur to the senses of the untaught savage, but as they have been arranged and distributed into parcels or assortments by the successive observations and reflections of our predecessors. Were these arrangements and distributions agreeable, in every instance, to sound philosophy, the chief source of the errors to which we are liable in all our general conclusions would be removed: but it would be too much to expect (with some late theorists) that even in the most advanced state, either of physical or of moral science, this supposition is ever to be realized in all its extent. At the same time, it must be remembered, that the obvious tendency of the progressive reason and experience of the species, is to diminish more and more the imperfections of the classifications which have been transmitted from ages of comparative ignorance; and, of consequence, to render language more and more a safe and powerful organ for the investigation of truth.

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* The same analogy had occured to Locke. "To shorten its way to knowledge, and make each perception more comprehensive, the mind binds them into bundles."

The only science which furnishes an exception to these observations is *mathematics*; a science essentially distinguished from every other by this remarkable circumstance, that the precise import of its generic terms is fixed and ascertained by the *definitions* which form the basis of all our reasonings, and in which, of consequence, the very possibility of error in our classifications is precluded, by the virtual identity of all those hypothetical objects of thought to which the same generic term is applied.

I intend to prosecute this subject farther, before concluding my observations on general reasoning. At present, I have only to add to the foregoing remarks, that, in the comprehensive theorems of the philosopher, as well as in the assortments of the tradesman, I cannot perceive a single step of the understanding, which implies any thing more than the notion of *number*, and the use of a common name.

Upon the whole it appears to me, that the celebrated dispute concerning abstract general ideas, which so long divided the schools, is now reduced, among correct thinkers, to this simple question of fact, Could the human mind, *without the use of signs of one kind or another*, have carried on general reasonings, or formed general conclusions? Before arguing with any person on the subject, I should wish for a categorical explanation on this preliminary point. Indeed, every other controversy connected with it turns on little more than the meaning of words.

A difference of opinion with respect to this question of *fact* (or rather, I suspect, a want of attention in some of the disputants to the great variety of *signs* of which the mind can avail itself, independently of words) still continues to keep up a sort of distinction between the Nominalists and the Conceptualists. As for the Realists, they may, I apprehend, be fairly considered, in the present state of science, as having been already forced to lay down their arms.

That the doctrine of the nominalists has been stated by some writers of note in very unguarded terms, I do not deny,* nor am I certain that it was ever delivered by

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* Particularly by Hobbes, some of whose incidental remarks and expressions would certainly, if followed strictly out to their logical consequences, lead to the complete subversion of truth, as a thing real, and independent of human opinion. It is to this, I presume, that Leibnitz alludes, when he says of him, "*Thomas Hobbes, qui ut verum fatear, mihi plus quam nominalis videtur.*"

I shall afterwards point out the mistake by which Hobbes seems to me to have been misled. In the meantime, it is but justice to him to say, that I do not think he had any intention to establish those sceptical conclusions which, it must be owned, may be fairly deduced as corollaries from some of his principles. Of this I would not wish for a stronger proof than his favourite maxim, that "words are the *counters* of wise men, but the *money of fools*;" a sentence which expresses, with marvellous conciseness, not only the proper function of language, as an instrument of reasoning, but the abuses to which it is liable, when in unskilful hands.

Dr. Gillies, who has taken much pains to establish Aristotle's claims to all that is valuable in the doctrine of the nominalists, has, at the same time, represented him as the only favourer of this opinion, by whom it has been taught without any admixture of those errors which are blended with it in the works of its modern revivers. Even Bishop Berkeley himself is involved with Hobbes and Hume in the same sweeping sentence of condemnation. "The language of the nominalists seems to have been extremely liable to be perverted to the purposes of scepticism, as taking away the specific distinctions of things; and is in fact thus perverted by Hobbes, any one of the schoolmen in a form completely unexceptionable; but after the luminous, and, at the same time, cautious manner in which it has been unfolded by Berkeley and his successors, I own it appears to me not a little surprising, that men of talents and candour should still be found inclined to shut their eyes against the light, and to shelter themselves in the darkness of the middle ages. For my own part, the longer and the more attentively that I reflect on the subject, the more am I disposed to acquiesce in the *eulogium* bestowed on Roscellinus and his followers by Leibnitz; one of the very few philosophers, if not the only philosopher, of great celebrity, who seems to have been fully aware of the singular merits of those by whom this theory was originally proposed: "SECTA NOMINALIUM, OMNIUM INTER SCHOLASTICAS PROFUNDISSIMA, ET HODIERNÆ REFORMATÆ PHILOSOPHANDI RATIONI CONGRUENTISSIMA." It is a theory, indeed, much more congenial to the spirit of the eighteenth than of the eleventh century; nor must it be forgotten, that it was proposed and maintained at a period when the algebraical art (or to express myself more precisely, *universal arithmetic*) from which we now borrow our best illustrations in explaining and defending it, was entirely unknown.

Berkeley, Hume, *and their innumerable followers*. But Aristotle's language is not liable to this abuse." (*Gillies's Aristotle*, Vol. I. p. 71, 2d edit.)

Among these sceptical followers of Berkeley, we must, I presume, include the late learned and ingenious Dr. Campbell; whose remarks on this subject I will, nevertheless, venture to recommend to the particular attention of my readers. Indeed, I do not know of any writer who has treated it with more acuteness and perspicuity. (See *Philosophy of Rhetoric*, Book II. chap. vii.)

II.

Continuation of the Subject.—Of Language considered as an Instrument of Thought.

HAVING been led, in defence of some of my own opinions, to introduce a few additional remarks on the controversy with respect to the theory of *general reasoning*, I shall avail myself of this opportunity to illustrate a little farther *another* topic, (intimately connected with the foregoing argument) on which the current doctrines of modern logicians seem to require a good deal more of explanation and restriction than has been commonly apprehended. Upon this subject I enter the more willingly, that, in my first volume, I have alluded to these doctrines in a manner which may convey, to some of my readers, the idea of a more complete acquiescence, on *my* part, in their truth, than I am disposed to acknowledge.

In treating of abstraction, I endeavoured to show that we *think*, as well as *speak*, by means of words, and that, without the use of language, our reasoning faculty (if it could have been at all exercised) must necessarily have been limited to *particular* conclusions alone. The effects, therefore, of ambiguous and indefinite terms are not confined to our communications with others, but extend to our private and solitary speculations. Dr. Campbell, in his Philosophy of Rhetoric, has made some judicious and important observations on this subject; and, at a much earlier period, it drew the attention of Des Cartes; who, in the course of a very valuable discussion with respect to

particular stress on
employment of lan-
And, lastly, in conse-
h, all our ideas become
ch we express them; nor
to memory, without their
is, that there is hardly any
so distinct a notion as to be
ted from all use of language;
mber words more easily than
much more conversant with the
r. Hence, too, it is, that we of-
propositions, the meaning of which
; imagining that we have either ex-
import of all the terms involved in
ve adopted these terms on the autho-
whose judgment we can rely."*

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ver loquelæ usum, conceptos omnes nostros verbis,
s, alligamus, nec eos, nisi simul cum istis verbis, me-
que facilius postea verborum quam rerum recorde-
s rei conceptum habemus tam distinctum, ut illum ab
n separemus; cogitationesque hominum fere om-
s quam circa res versantur; adeo ut persæpe vocibus
at assensum, quia putant se illos olim intellexisse,
recte intelligebant, accepisse."—*Princ. Phil.* Pars

curious passage nearly to the same purpose, from
exed to my first volume (see note L.) I was not then
attention which had been given to this source of er-
er did I expect to find so explicit an allusion to it in
stle, as I have *since* observed in the following para-

[illegible] μὲν, ὅτι μαθ-
[illegible] μὲν γὰρ μετ'
[illegible] πράγματι

To these important considerations, it may be worth while to add, that whatever improvements may yet be made in language, by philosophers, they never can relieve the student from the indispensable task of analyzing with accuracy the complex ideas he annexes to the terms employed in his reasonings. The use of general terms, as Locke has remarked, is learned, in many cases, before it is possible for us to comprehend their meaning; and the

ειτα, και καθ' ἀυτους απατασθαι συμβαινει, ὁταν επι τȣ λογȣ ποιηται την σκεψιν· ετι, ἡ μεν απατη εκ της ὁμοιοτητος· ἡ δε ὁμοιοτης, εκ της λεξεως. *De Sophist. Elenchis*, Lib. I. cap. 7.

Quocirca inter eos (Paralogismos) qui in dictione, consistunt, hic fallendi modus est ponendus. Primum, quia magis decipimur considerantes cum aliis, quàm apud nosmetipsos, nam consideratio cum aliis per sermonem instituitur; apud nosmetipsos autem non minus fit per rem ipsam. Deinde et per nosmetipsos ut fallumur accidit, cum in rebus considerandis sermo adhibetur: Præterea deceptio est ex similitudine: similitudo autem ex dictione."—Edit. *Du Val*. Vol. I. p. 289.

Lest it should be concluded, however, from this detached remark, that Aristotle had completely anticipated Locke and Condillac in their speculations with respect to language, considered as *an instrument of thought*, I must beg of my readers to compare it with the previous enumeration given by the same author, of those paralogisms or fallacies which lie *in the diction*, (*De Sophist. Elenchis*, Lib. I. cap. 4.)—recommending to them, at the same time, as a useful comment on the original, the twentieth chapter of the third book of a work entitled *Institutio Logica*, by the learned and justly celebrated Dr. Wallis of Oxford. I select this work in preference to any other modern one on the same subject, as it has been lately pronounced, by an authority for which I entertain a sincere respect, to be "a complete and accurate treatise of logic, strictly according to the Aristotelian method;" and as we are farther told, that it is "still used by many in the university to which Wallis belonged, as the lecture-book in that department of study." I intend to quote part of this chapter on another occasion. At present I shall only observe, that it does not contain the slightest reference to the passage which has led me to introduce these observations; and which, I believe, will be now very generally allowed to be of greater value than all those puerile distinctions put together, which Dr. Wallis has been at so much pains to illustrate and exemplify.

to use them through life.
to examine accurately
This is a study which every
for himself; and of which no
soever they may be in directing
the necessity.

ility of a cautious employment of
edium of communication and as an in-
ent, many striking illustrations might be
he history of science during the time
ic jargon was current among the learn-
phraseology, which was not only ill-
the discovery of truth, but which was
contrived for the propagation of error; and
those who were habituated to the use of it,
ages in controversy (at least in the judgment
ude) over their more enlightened and candid
“A blind wrestler, by fighting in a dark
to adopt an allusion of Des Cartes) may not on-
his defect, but may enjoy some advantages
who see. It is the light of day only that can
his inferiority.” The imperfections of this phi-
accordingly, have been exposed by Des Cartes
followers, less by the force of their reasonings,
their teaching men to make use of their own facul-
ead of groping in the artificial darkness of the
and to perceive the folly of expecting to advance
by ringing changes on words to which they an-
no clear or precise ideas.

consequence of the influence of these views, the at-
on of our soundest philosophers was more and more
during the course of the last century, to the culti-

vation of that branch of logic which relates to the use of words. Mr. Locke's observations on this subject form perhaps the most valuable part of his writings; and, since his time, much additional light has been thrown upon it by Condillac and his successors.

Important, however, as this branch of logic is in its practical applications; and highly interesting, from its intimate connexion with the theory of the human mind, there is a possibility of pushing, to an erroneous and dangerous extreme, the conclusions to which it has led. Condillac himself falls, in no inconsiderable a degree, under this censure; having, upon more than one occasion, expressed himself as if he conceived it to be possible, by means of precise and definite terms, to reduce reasoning, in all the sciences, to a sort of mechanical operation, analogous, in its nature, to those which are practised by the algebraist, on letters of the alphabet. "The art of reasoning (he repeats over and over) is nothing more than a language well arranged.—"L'art de raisonner se rèduit à une langue bien faite."

One of the first persons, as far as I know, who objected to the vagueness and incorrectness of this proposition, was M. De Gerando; to whom we are farther indebted for a clear and satisfactory exposition of the very important *fact* to which it relates. To this fact Condillac approximates nearly in various parts of his works; but never, perhaps, without some degree of indistinctness and of exaggeration. The point of view in which it is placed by his ingenious successor, strikes me as so just and happy, that I cannot deny myself the pleasure of enriching my book with a few of his observations.

It is the distinguishing characteristic of a lively and ingenious imagination, to push its speculative conclusions somewhat beyond their just limits. Hence, in the logical writings of this estimable writer, these maxims (stated without any explanation, or restriction,) '*That the study of a science is nothing more than the acquisition of a language;*' and '*that a science properly treated is only a language well contrived.*' Hence the rash assertion, '*that mathematics possess no advantage over other sciences, but what they derive from a better phraseology: and that all of these might attain to the same characters of simplicity and of certainty, if we knew how to give them signs equally perfect.*'"*

"The same task which must have been executed by those who contributed to the first formation of a language, and which is executed by every child when he learns to speak it, is repeated over in the mind of every adult when he makes use of his mother-tongue; for it is only by the decomposition of his thoughts that he can learn to select the signs which he ought to employ, and to dispose them in a suitable order. Accordingly, those external actions which we call *speaking* or *writing*, are always accompanied with a philosophical process of the understanding, unless we content ourselves, as too often happens, with repeating over mechanically what has been said by others. It is in *this* respect that languages, with their forms and rules, conducting (so to speak) those who use them, into the habits of a regular analysis; tracing out to them in a well-ordered discourse, the model of a perfect decomposition, may be regarded, *in a certain sense*, as *analytical methods*.——But I stop short; Condillac, to whom this idea belongs, has developed it too well to leave any hope of improving upon his statement."

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* Des Signes et de l'Art de Penser, &c. Introd. pp. xx. xxi.

In a note upon this passage, however, M. De Gerando has certainly improved not a little on the statement of Condillac. "In asserting (says he) that languages may be regarded as analytical methods, I have added the qualifying phrase, *in a certain sense*, for the word *method* cannot be employed here with exact propriety. Languages furnish the *occasions* and the *means of analysis;* that is to say, they afford us assistance in *following* that method; but they are not the method itself. They resemble signals or finger-posts placed on a road to enable us to discover our way; and if they help us to analyze, it is because they are themselves the results, and as it were, the monuments of an analysis which has been previously made; nor do they contribute to keep us in the right path, but in proportion to the degree of judgment with which that analysis has been conducted."*

I was the more solicitous to introduce these excellent remarks, as I suspect that I have myself indirectly contributed to propagate in this country the erroneous opinion which it is their object to correct. By some of our later writers it has not only been implicitly adopted, but has been regarded as a conclusion of too great value to be suffered to remain in the quiet possession of the moderns. "Aristotle (says the author of a very valuable analysis of his works) *well knew* that our knowledge of *things* chiefly depending on the proper application of language as an INSTRUMENT OF THOUGHT, the true art of reasoning is nothing but a language accurately defined and skilfully arranged; an opinion which, after many idle declamations against his barren generalities and verbal trifling, philosophers have begun very generally to adopt."[*]

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* Ibid. pp. 158, 159, Tom. I.

[*] Aristotle's Ethics, &c. by Dr. Gillies, Vol. I. p. 94, 2d. edit.

The passage in my first volume, to which I suspect an allusion is here made, is as follows:

"The technical terms, in the different sciences, render the appropriate language of philosophy a still more convenient INSTRUMENT OF THOUGHT, than those languages which have originated from popular use; and in proportion as these technical terms improve in point of precision and of comprehensiveness, they will contribute to render our intellectual progress more certain and more rapid. 'While engaged (says Mr. Lavoisier) in the composition of my Elements of Chemistry, I perceived, better than I had ever done before, the truth of an observation of Condillac, that we think only through the medium of words, and that *languages are true analytic methods.* Algebra, which, of all our modes of expression, is the most simple, the most exact, and the best adapted to its purpose, is, at the same time, a language and an analytical method. *The art of reasoning is nothing more than a language well arranged.*' The influence (I have added) which these very enlightened and philosophical views have already had on the doctrines of chemistry, cannot fail to be known to most of my readers."

When this paragraph was first written, I was fully aware of the looseness and indistinctness of Lavoisier's expressions; but as my only object in introducing the quotation was to illustrate the influence of general logical principles on the progress of particular sciences, I did not think it necessary, in the *introduction* to my work, to point out in what manner Condillac's propositions were to be limited and corrected. I am truly happy, for the sake of M. De Gerando, that I happened to transcribe them in the same vague and very exceptionable terms in which I found them sanctioned by the names of Condillac, and of one of the most illustrious of his disciples.

It will not, I hope, be considered as altogether foreign to the design of this note, if I remark further, how easy it is for a translator of Aristotle (in consequence of the unparalleled brevity which he sometimes affects) to accommodate the sense of the original, by the help of paraphrastical clauses, expressed in the phraseology of modern science, to every progressive step in the history of human knowledge. In truth, there is not one philosopher

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ion which we are here told
enerally to adopt," it is to be
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amental article of logic than the Sta-

hose opinions, when they are stated in any terms but his
o be received with so great distrust.

III.

Continuation of the subject.—Visionary Theories of some Logicians, occasioned by their inattention to the Essential Distinction between Mathematics and other Sciences.

In a passage already quoted from De Gerando, he takes notice of what he justly calls a *rash assertion of Condillac*, "that mathematics possess no advantage over other sciences, but what they derive from a better phraseology; and that all of them might attain to the same characters of simplicity and of certainty, if we knew how to give them *signs* equally perfect."

Leibnitz seems to point at an idea of the same sort, in those obscure and enigmatical hints (not altogether worthy, in my opinion, of his powerful and comprehensive genius) which he has repeatedly thrown out, about the miracles to be effected by a new art of his own invention; to which art he sometimes gives the name of *Ars Combinatoria Characteristica*, and sometimes of *Ars Combinatoria Generalis ac Vera*. In one of his letters to Mr. Oldenburg, he speaks of a plan he had long been meditating, of treating of the science of mind by means of mathematical demonstrations. "Many wonderful things (he adds) of this kind have occurred to me; which, at some future period, I shall explain to the public with that logical precision which the subject requires."* In the same letter, he intimates his belief in the possibility of inventing an art, "which, with an exactitude resembling that of me-

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* Multa in hoc genere mira à me sunt observata, quæ aliquando, to par est rigore, exposita dabo."

ne operations of reason steady and
effects on the minds of others, irre-
fter which he proceeds thus:
algebra, which we justly value so highly,
a branch of that general art which I have
But, such as it is, it puts it out of our power
n error, even although we should wish to do
it exhibits truth to our eyes like a picture stamp-
per by means of a machine. It must at the same
e recollected, that algebra is indebted for whatever
ccomplishes in the demonstration of *general* theorems
to the suggestions of a higher science; a science which I have been accustomed to call *characteristical combination*; very different, however, in its nature from that which these words are likely, at first, to suggest to the hearer. The marvellous utility of this art I hope to illustrate, both by precepts and examples, if I shall be so fortunate as to enjoy health and leisure.

"It is impossible for me to convey an adequate idea of it in a short description. But this I may venture to assert, that no instrument (or organ) could easily be imagined of a more powerful efficacy for promoting the improvement of the human understanding; and that, supposing it to be adopted, as the common method of philosophizing, the time would very soon arrive, when we should be able to form conclusions concerning God and the Mind, with not less certainty than we do at present concerning figures and numbers.†"

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* "Quod velut mechanica ratione fixam et visibilem et (ut ita dicam) irresistibilem reddat rationem."

† Wallisii Opera, Vol. III. p. 621.

The following passage is translated from another letter of Leibnitz to the same correspondent:

"The matter in question depends on another of much higher moment; I mean, on a *general and true art of combination*, of the extensive influence of which I do not know that any person has yet been fully aware. This, in truth, does not differ from that sublime analysis, into the recesses of which Des Cartes himself, as far as I can judge, was not able to penetrate. But, in order to carry it into execution, an alphabet of human thoughts must be previously formed; and for the invention of this alphabet, an analysis of axioms is indispensably necessary. I am not, however, surprised, that nobody has yet sufficiently considered it; for we are, in general, apt to neglect what is easy; and to take many things for granted, from their apparent evidence; faults, while they remain uncorrected, will for ever prevent us from reaching the summit of things intellectual, by the aid of a *calculas* adapted to moral as well as to mathematical science."*

In these extracts from Leibnitz, as well as in that quoted from Condillac, in the beginning of this article, the essential distinction between mathematics and the other sci-

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* Wallisii Opera, Vol. III. p. 633.

As these reveries of this truly great man are closely connected with the subsequent history of logical speculation in more than one country of Europe, I have been induced to incorporate them, in an English version, with my own disquisitions. Some expressions, which, I am sensible, are not altogether agreeable to the idiom of our language, might have been easily avoided, if I had not felt it incumbent on me, in translating an author whose meaning, in this instance, I was able but very imperfectly to comprehend, to deviate as little as possible from his own words.

irely overlooked. In
ambiguous word
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hing resembling the
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on language into that of al-
from the view; and the subse-
st mechanically regulated by ge-
nal result is obtained. In the latter
ords about which our reasonings are con-
, more or less, of different shades of mean-
is only by considering attentively the relation
they stand to the immediate context, that the pre-
idea of the author in any particular instance is to be
scertained. In these sciences, accordingly, the constant and unremitting exercise of the attention is indispensably necessary, to prevent us, at every step of our progress, from going astray.

On this subject I have made various remarks in a volume lately published; to which I beg leave here to refer, in order to save the trouble of unnecessary repetitions.* From what I have there said, I trust it appears that, in following any train of reasoning, beyond the circle of the mathematical sciences, the mind must necessarily carry on along with the logical deduction expressed in words, another logical process of a far nicer and more difficult nature;—that of fixing, with a rapidity which escapes our memory, the precise sense of every word which is ambiguous, by the relation in which it stands to the general

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* Philosophical Essays, p. 153. et seq.

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be p re precise distinction and classifi-
bet eanings of words, than in a reduc-
an in point of number, the task of men-
k erpretation may be rendered more
but the necessity of this task can re-
till every word which we employ shall
ariable in its signification as an algebra-
the name of a geometrical figure.

ne, the intellectual superiority of one man
in all the different branches of moral and
sophy, will be found to depend chiefly on
h which he has cultivated these *silent ha-*
ve interpretation,—much more, in my opin-
as acquaintance with those rules which form
ects of study to the professed logician. In proof
sufficient for me to remind my readers, that
theory of syllogism proceeds on the supposition
same word is always to be employed precisely in
e sense, (for otherwise, the syllogism would
ed by consisting of more than *three terms*) and con-
ly, it takes for granted, in every rule which it furnish-
e guidance of our reasoning powers, that the nicest,

by far the most difficult part of the logical process has en previously brought to a successful termination.

In treating of a different question, I have elsewhere remarked, that although many authors have spoken of the wonderful *mechanism of speech*, none has hitherto attended to the far more wonderful *mechanism* which it puts into action behind the scene. A similar observation will be found to apply to what is commonly called the Art of Reasoning. The scholastic precepts which profess to teach it, reach no deeper than the very surface of the subject: being, all of them, confined to that part of the intellectual process which is embodied in the form of verbal propositions. On the most favourable supposition which can be formed with respect to them, they are superfluous and nugatory; but, in many cases, it is to be apprehended, that they interfere with the right conduct of the understanding, by withdrawing the attention from the cultivation of that mental logic on which the soundness of our conclusions essentially depends, and in the study of which (although some general rules may be of use) every man must be, in a great measure, his own master.*

In the practical application of the foregoing conclusions, it cannot fail to occur, as a consideration equally obvious and important, that, in proportion as the objects of our reasoning are removed from the particular details with which our senses are conversant, the difficulty of these latent inductive processes must be increased. This is the real source of that incapacity for general speculation, which Mr. Hume has so well described as a distinguishing characteristic of uncultivated minds. "General reasonings seem intricate, merely because they are general; nor is it easy for the bulk of mankind to distinguish, in a great number of particulars, that common circumstance in which they all agree, or to extract it, pure and unmixed, from the other superfluous circumstances. Every judgment or conclusion with them is particular. They cannot enlarge their views to those universal propositions which comprehend under them an infinite number of individuals, and include a whole science in a single theorem. Their eye is confounded with such an extensive prospect, and the conclusions deduced from it, even though clearly expressed, seem intricate and obscure."*

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* Those who are interested in this discussion, will enter more completely into my views, if they take the trouble to combine what is here stated with some observations I have introduced in the first volume of this work. See p. 177, et seq. 3d edit.

Difficult, however, and even impossible, as the task of general speculation is to the bulk of mankind, it is nevertheless true, that it is the path which leads the cautious and skilful reasoner to all his most certain, as well as most valuable conclusions in morals and in politics. If a theorist, indeed, should expect, that these conclusions are in every particular instance to be realized, he would totally misapprehend their nature and application; inasmuch as they are only to be brought to an experimental test, by viewing them on an extensive scale, and continuing our observations during a long period of time. "When a man deliberates (says Mr. Hume) concerning his conduct in any *particular* affair, and forms schemes in politics, trade, economy, or any business in life, he never ought to draw his arguments too fine, or connect too long a chain of consequences together. Something is sure to happen that will disconcert his reasoning, and produce an event different from what he expected. But when we reason upon *general* subjects, one may justly affirm, that our speculations can scarcely ever be too fine, provided they be just; and that the difference between a common man and a man of genius is chiefly seen in the shallowness or depth of the principles on which they proceed." The same author afterwards excellently observes, That general principles, however intricate they may seem, must always prevail, if they be just and sound, in the general course of things, though they may fail in particular cases; and that it is the chief business of philosophers to regard the general course of things."—"I may add (continues Mr. Hume) that it is also the chief business of politicians, especially in the domestic government of the state, where the public good, which is, or ought to be, their object, depends on the concurrence of a multitude of causes; not as in foreign politics, on accidents and chances, and the caprices of a few persons."*

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* Essay on Commerce.

To these profound reflections of Mr. Hume, it may be added (although the remark does not bear directly on our present argument) that, in the systematical application of general and refined rules to their private concerns, men frequently err from calculating their measures upon a scale disproportionate to the ordinary duration of human life. This is one of the many mistakes into which projectors are apt to fall; and hence the ruin which so often overtakes them, while sowing the seeds of a harvest which others are to reap. A few years more might have secured to themselves the prize which they had in view; and changed the opinion of the world (which is always regulated by the accidental circumstances of failure or of success) from contempt of their folly, into admiration of their sagacity and perseverance.

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* Essay on Commerce.

This contrast between the domestic and the foreign policy of a state, occurs more than once in Mr. Hume's writings; (see in particular the first paragraphs of his Essay on the Rise of Arts and Sciences.) A similar observation had long before been made by Polybius. "There are two ways by which every kind of government is destroyed: either by some accident that happens from without; or some evil that arises within itself. What the first will be, it is not always easy to foresee; but *the latter is certain and determinate.*—Book VI. Ex. 3. (Hampton's Translation.)

It is observed by the Comte de Bussi, that "time remedies all mischances; and that men die unfortunate, only because they did not live long enough. Mareschal d'Estree, who died rich at a hundred, would have died a beggar, had he lived only to eighty." The maxim, like most other apothegms, is stated in terms much too unqualified; but it may furnish matter for many interesting reflections, to those who have surveyed with attention the characters which have passed before them on the stage of life; or who amuse themselves with marking the trifling and fortuitous circumstances by which the multitude are decided in pronouncing their verdicts of foresight or of improvidence.

IV.

Continuation of the Subject.—Peculiar and supereminent Advantages possessed by Mathematicians, in consequence of their definite Phraseology.

If the remarks contained in the foregoing articles of this section be just, it will follow, that the various artificial aids to our reasoning powers which have been projected by Leibnitz and others, proceed on the supposition (a supposition which is also tacitly assumed in the syllogistic theory) that, in all the sciences, the words which we employ have, in the course of our *previous* studies, been brought to a sense as unequivocal as the phraseology of mathematicians. They proceed on the supposition, therefore, that by far the most difficult part of the logical problem has been already solved. Should the period ever arrive, when the language of moralists and politicians shall be rendered as perfect as that of geometers and algebraists, *then*, indeed, may such contrivances as the *Ars Combinatoria* and the *Alphabet of human thoughts*, become interesting subjects of philosophical discussion; although the probability is, that, even were that era to take place, they would be found nearly as useless in morals and politics, as the syllogistic art is acknowledged to be at present, in the investigations of pure geometry.

Of the peculiar and supereminent advantage possessed by mathematicians, in consequence of those fixed and de-those relations which form the objects of their science, and the correspondent precision in their language and reasonings. I can think of no illustration more striking than what is afforded by Dr. Halley's Latin version from an Arabic manuscript, of the two books of Appollonius *Pergæus de Sectione Rationis.* The extraordinary circumstances under which this version was attempted and completed (which I presume are little known beyond the narrow circle of mathematical readers) appear to me so highly curious, considered as matter of literary history, that I shall copy a short detail of them from Halley's preface.

After mentioning the accidental discovery in the Bodleian library, by Dr. Bernard, Savilian Professor of astronomy, of the Arabic version of Appollonius, περι λογυ αποτομης, Dr. Halley proceeds thus:

"Delighted, therefore, with the discovery of such a treasure, BERNARD applied himself diligently to the task of a Latin translation. But before he had finished a tenth part of his undertaking, he abandoned it altogether, either from his experience of its growing difficulties, or from the pressure of other avocations. Afterwards, when, on the death of Dr. Wallis, the Savilian professorship was bestowed on me, I was seized with a strong desire of making a trial to complete what Bernard had begun;—an attempt, of the boldness of which the reader may judge, when he is informed, that, in addition to my own entire ignorance of the Arabic language, I had to contend with the obscurities occasioned by innumerable passages which were either defaced or altogether obliterated. With the assistance, however, of the sheets which Bernard had left, and which served me as a key for investigating the sense of the original, I began first with making a list of those words, the signification of which his version had clearly ascertained; and then proceeded, by comparing these words, wherever they occurred, with the train of reasoning in which they were involved, to decypher, by slow degrees, the import of the context; till at last I succeeded in mastering the whole work, and in bringing my translation (without the aid of any other person) to the form in which I now give it to the public."*

When a similar attempt shall be made with equal success, in decyphering a moral or a political treatise written in an unknown tongue, *then*, and not till *then*, may we think of comparing the phraseology of these two sciences with the simple and rigorous language of the Greek geometers; or with the more refined and abstract, but not less scrupulously logical system of *signs*, employed by modern mathematicians.

It must not, however, be imagined, that it is solely by the nature of the ideas which form the objects of its reasonings, even when combined with the precision and unambiguity of its phraseology, that mathematics is distinguished from the other branches of our knowledge. The *truths* about which it is conversant, are of an order altogether peculiar and singular; and the *evidence* of which they admit resembles nothing, either in degree or in kind, to which the same name is given, in any of our other intellectual pursuits. On these points also, Leibnitz and many other great men, have adopted very incorrect opinions; and, by the authority of their names, have given currency to some logical errors of fundamental importance. My reasons for so thinking, I shall state as clearly and fully as I can, in the following section.

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* Appollon. Perg. de Sectione Rationis, &c. Opera et Studio Edm. Halley. Oxon. 1706. In Præfat.

SECTION III.

Of Mathematical Demonstration.

I.

Of the Circumstance on which Demonstrative Evidence essentially depends.

THE peculiarity of that species of evidence which is called demonstrative, and which so remarkably distinguishes our mathematical conclusions from those to which we are led in other branches of science, is a fact which must have arrested the attention of every person who possesses the slightest acquaintance with the elements of geometry. And yet I am doubtful if a satisfactory account has been hitherto given of the circumstance from which it arises. Mr. Locke tells us, that "what constitutes a demonstration is intuitive evidence at every step;" and I readily grant, that if in a single step such evidence should fail, the other parts of the demonstration would be of no value. It does not, however, seem to me that it is on this consideration that the demonstrative evidence of the conclusion depends,—not even when we add to it another which is much insisted on by Dr. Reid,—that, "in demonstrative evidence, our first principles must be intuitively certain." The inaccuracy of this remark I formerly pointed out when treating of the evidence of axioms; on which occasion I also observed, that the first principles of our reasonings in mathematics are not *axioms*, but *definitions*. It is in this last circumstance (I mean the peculiarity of reasoning from *definitions*) that the true theory of mathematical demonstration is to be found; and I shall accordingly endeavour to explain it at considerable length, and to state some of the more important consequences to which it leads.

That I may not, however, have the appearance of claiming in behalf of the following discussion, an undue share of originality, it is necessary for me to remark, that the leading idea which it contains has been repeatedly started, and even to a certain length prosecuted, by different writers, ancient as well as modern; but that, in all of them, it has been so blended with collateral considerations, altogether foreign to the point in question, as to divert the attention both of writer and reader, from that single principle on which the solution of the problem hinges. The advantages which mathematics derives from the peculiar nature of those relations about which it is conversant; from its simple and definite phraseology; and from the severe logic so admirably displayed in the concatenation of its innumerable theorems, are indeed immense, and well entitled to a separate and ample illustration; but they do not appear to have any necessary connexion with the subject of this section. How far I am right in this opinion, my readers will be enabled to judge by the sequel.

It was already remarked, in the first chapter of this Part, that whereas, in all other sciences, the propositions which we attempt to establish, express facts real or supposed,—in mathematics, the propositions which we demonstrate only assert a connexion between certain suppositions and certain consequences. Our reasonings, therefore, in mathematics, are directed to an object essentially different from what we have in view, in any other employment of our intellectual faculties;—not to ascertain *truths* with respect to actual existencies, but to trace the logical filiation of consequences which follow from an assumed *hypothesis*. If from this *hypothesis* we reason with correctness, nothing, it is manifest, can be wanting to complete the evidence of the result; as this result only asserts a necessary connexion between the supposition and the conclusion. In the other sciences, admitting that every ambiguity of language were removed, and that every step of our deductions were rigorously accurate, our conclusions would still be attended with more or less of uncertainty: being ultimately founded on principles which may or may not, correspond exactly with the fact.*

Hence it appears, that it might be possible, by devising a set of arbitrary definitions, to form a science, which, although conversant about moral, political, or physical ideas, should yet be as certain as geometry. It is of no moment, whether the definitions assumed correspond with facts or not, provided they do not express impossibilities, and be not inconsistent with each other. From these principles a series of consequences may be deduced by the most unexceptionable reasoning; and the results obtained will be perfectly analogous to mathematical propositions. The terms *true* and *false*, cannot be applied to them; at least in the sense in which they are applicable to propositions relative to facts. All that can be said is, that they are or are not connected with the definitions which form the principles of the science; and, therefore, if we choose to call our conclusions *true* in the one case, and *false* in the other, these epithets must be understood merely to refer to their connexion with the *data*, and not to their correspondence with things actually existing, or with events which we expect to be realized in future. An example of such a science as that which I have now been describing, occurs in what has been called by some writers *theoretical mechanics;* in which from arbitrary hypothesis concerning physical laws, the consequences are traced which *would* follow, if such was really the order of nature.

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* This distinction coincides with one which has been very ingeniously illustrated by M. Prevost in his philosophical essays. See his remarks on those sciences which have for their object *absolute truth*, considered in contrast with those which are occupied only about *conditional or hypothetical truths*. Mathematics is a science of the latter description; and is therefore called by M. Prevost *a science of pure reasoning*. In what respects my opinion on this subject differs from his, will appear afterwards.—*Essais de Philosophie*, Tom. II. p. 9. et seq:

In those branches of study which are conversant about moral and political propositions, the nearest approach which I can imagine to a hypothetical science, analogous to mathematics, is to be found in a code of municipal jurisprudence; or rather might be conceived to exist in such a code, if systematically carried into execution, agreeably to certain general or fundamental principles. Whether these principles should or should not be founded in justice and expediency, it is evidently possible, by reasoning from them consequentially, to create an artificial or conventional body of knowledge, more systematical, and, at the same time, more complete in all its parts, than, in the present state of our information, any science can be rendered, which ultimately appeals to the eternal and immutable standards of truth and falsehood, of right and wrong. This consideration seems to me to throw some light on the following very curious parallel which Leibnitz has drawn (with what justness I presume not to decide) between the works of the Roman civilians and those of the Greek geometers. Few writers certainly have been so fully qualified as he was to pronounce on the characteristical merits of both.

" I have often said, that, after the writings of geometricians there exists nothing which, in point of force and of subtilty, can be compared to the works of the Roman lawyers. And, as it would be scarcely possible, from mere intrinsic evidence, to distinguish a demonstration of Euclid's from one of Archimedes or of Appollonius (the style of all of them appearing no less uniform than if reason herself was speaking through their organs,) so also the Roman lawyers all resemble each other like twin-brothers; insomuch that, from the style alone of any particular opinion or argument, hardly any conjecture could be formed with respect to the author. Nor are the traces of a refined and deeply meditated system of natural jurisprudence anywhere to be found more visible, or in greater abundance. And, even in those cases where its principles are departed from, either in compliance with the language consecrated by technical forms, or in consequence of new statutes, or of ancient traditions, the conclusions which the assumed hypothesis renders it necessary to incorporate with the eternal dictates of right reason, are deduced with the soundest logic, and with an ingenuity which excites admiration. Nor are these deviations from the law of nature so frequent as is commonly imagined."*

I have quoted this passage merely as an illustration of the analogy already alluded to, between the systematical unity of mathematical science, and that which is *conceivable* in a system of municipal law. How far this unity is exemplified in the Roman code, I leave to be determined by more competent judges.†

As something analogous to the hypothetical or conditional conclusions of mathematics may thus be fancied to take place in speculations concerning moral or political subjects, and actually does take place in theoretical mechanics; so, on the other hand, if a mathematician should affirm, of a general property of the circle, that it applies to a particular figure described on paper, he would at once degrade a geometrical theorem to the level of a fact resting ultimately on the evidence of our imperfect senses. The accuracy of his reasoning could never bestow on his proposition that peculiar evidence which is properly called *mathematical*, as long as the fact remained uncertain, whether all the straight lines drawn from the centre to the circumference of the figure were mathematically equal.

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* Leibnitz, Op. Tom. IV. p. 254.

† It is not a little curious, that the same code which furnished to this very learned and philosophical jurist, the subject of the *eulogium* quoted above, should have been lately stigmatized by an English lawyer, eminently distinguished for his acuteness and orignality, as "an enormous mass of confusion and inconsistency." Making all due allowances for the exaggerations of Leibnitz, it is difficult to conceive that his opinion, on a subject which he had so profoundly studied, should be so very widely at variance with the truth.

These observations lead me to remark a very common misconception concerning mathematical definitions; which are of a nature essentially different from the definitions employed in any of the other sciences. It is usual for writers on logic, after taking notice of the errors to which we are liable in consequence of the ambiguity of words, to appeal to the example of mathematicians, as a proof of the infinite advantage of using, in our reasonings, such expressions only as have been carefully defined. Various remarks to this purpose occur in the writings both of Mr. Locke and of Dr. Reid. But the example of mathematicians is by no means applicable to the sciences in which these eminent philosophers propose that it should be followed; and, indeed if it were copied as a model in any other branch of human knowledge, it would lead to errors fully as dangerous as any which result from the imperfections of language. The real fact is, that it has been copied much more than it ought to have been, or than would have been attempted, if the peculiarities of mathematical evidence had been attentively considered.

That in mathematics there is no such thing as an ambiguous word, and that it is to the proper use of definitions we are indebted for this advantage, must unquestionably be granted. But this is an advantage easily secured, in consequence of the very limited vocabulary of mathematicians, and the distinctness of the ideas about which their reasonings are employed. The difference, besides, in *this* respect, between mathematics and the other sciences, however great, is yet only a difference in degree; and is y no means sufficient to account for the essential distinction which every person must perceive between the irresistible cogency of a mathematical demonstration, and that of any process of reasoning.

From the foregoing considerations it appears, that in mathematics, definitions answer two purposes; first, To prevent ambiguities of language; and, secondly, To serve as the principles of our reasoning. It appears further, that it is to the latter of these circumstances (I mean to the employment of hypotheses instead of facts, as the data on which we proceed) that the peculiar force of demonstrative evidence is to be ascribed. It is however only in the *former* use of definitions, that any parallel can be drawn between mathematics and those branches of knowledge which relate to facts; and, therefore, it is not a fair argument in proof of their *general* utility, to appeal to the unrivalled certainty of mathematical science,—a pre-eminence which that science derives from a source altogether different, though comprehended under the same name, and which she will for ever claim as her own exclusive prerogative.*

Nor ought it to be forgotten, that it is in pure mathematics alone, that definitions can be attempted with propriety at the outset of our investigations. In most other instances, some previous discussion is necessary to show, that the definitions which we lay down correspond with facts; and in many cases, the formation of a just definition is the end to which our inquiries are directed. It is very judiciously observed by Mr. Burke, in his essay on Taste, that "when we define, we are in danger of circumscribing nature within the bounds of our own notions, which we often take up by hazard, or embrace on trust, or form out of a limited and partial consideration of the object before us, instead of extending our ideas to take in all that nature comprehends, according to her manner of combining. We are limited in our inquiry by the strict laws to which we have submitted at our setting out."

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* These two classes of definitions are very generally confounded by logicians; among others, by the Abbé de Condillac. See *La Logique, ou les premiers développemens de l'Art de Penser*, Chap. VI.

The same author adds, that "a definition may be very exact, and yet go but a very little way towards informing us of the nature of the thing defined;" and that, "in the order of things, a definition (let its virtue be what it will) ought rather to follow than to precede our inquiries, of which it ought to be considered as the result."

From a want of attention to these circumstances, and from a blind imitation of the mathematical arrangement, in speculations where facts are involved among the principles of our reasonings, numberless errors in the writings of philosophers might be easily traced. The subject is of too great extent to be pursued any farther here; but it is well entitled to the examination of all who may turn their thoughts to the reformation of logic. That the ideas of Aristotle himself, with respect to it, were not very precise, must, I think, be granted, if the following statement of his ingenious commentator be admitted as correct.

"Every general term (says Dr. Gillies) is considered by Aristotle as the abridgment of a definition; and every definition is denominated by him a *collection*, because it is the result always of observation and comparison, and often of many observations and of many comparisons."[*]

These two propositions will be found, upon examination, not very consistent with each other. The first, "That every general term is the abridgment of a definition," applies indeed admirably to mathematics; and touches with singular precision on the very circumstance which constitutes (in my opinion) the peculiar cogency of mathematical reasoning. But it is to mathematics that it applies exclusively. If adopted as a logical maxim in other branches of knowledge, it would prove an endless source of sophistry and error.—The second proposition, on the other hand, "That every definition is the result of observation and comparison, and often of many observations and many comparisons," however applicable to the definitions of natural history, and of other sciences which relate to *facts*, cannot, in one single instance, apply to the definitions of geometry; inasmuch as these definitions are neither the result of observations nor of comparisons, but the *hypotheses*, or first principles, on which the whole science rests.

If the foregoing account of demonstrative evidence be just, it follows, that no chain of reasoning whatever can deserve the name of a *demonstration* (at least in the mathematical sense of that word) which is not ultimately resolvable into hypotheses or definitions.[†] It has been already shown, that this is the case with geometry: And it is also manifestly the case with arithmetic, another science to which, in common with geometry, we apply the word mathematical. The simple arithmetical equations $2 + 2 = 4$; $2 + 3 = 5$, and other elementary propositions of the same sort, are (as was formerly observed) mere *definitions*;* perfectly analogous, in this respect, to those at the beginning of Euclid; and it is from a few fundamental principles of this sort, or at least from principles which are essentially of the same description, that all the more complicated results in the science are derived.

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[*] Gillies's Aristotle, Vol. I. p. 92, 2d edit.

[†] Although the account given by Locke of what constitutes a *demonstration*, be different from that which I have here proposed, he admits the *converse* of this doctrine as manifest; viz. That if we reason accurately from our own definitions, our conclusions will possess *demonstrative evidence*;

To this general conclusion, with respect to the nature of mathematical demonstration, an exception may perhaps be, at first sight, apprehended to occur, in our reasonings concerning geometrical *problems*: all of these reasonings (as is well known) resting ultimately upon a particular class of principles called *postulates*, which are commonly understood to be so very nearly akin to *axioms*, that both might, without impropriety, be comprehended under the same name. "The definition of a postulate (says the learned and ingenious Dr. Hutton) will nearly agree also to an axiom, which is a self-evident

and "hence (he observes with great truth) it comes to pass, that one may often meet with very clear and coherent discourses, that amount yet to nothing." He afterwards remarks, that "one may make demonstrations and undoubted propositions in words, and yet thereby advance not one jot in the knowledge of the truth of things." "Of this sort (he adds) a man may find an infinite number of propositions, reasonings, and conclusions, in books of metaphysics, school-divinity, and some sort of natural philosophy; and, after all, know as little of God, spirits, or bodies, as he did before he set out."—*Essay on Human Understanding*, Book IV. chap. viii.

* See page 32.

theorem, as a postulate is a self-evident problem."* The same author, in another part of his work, quotes a remark from Dr. Barrow, that "there is the same affinity between postulates and problems, as between axioms and theorems."† Dr. Wallis, too, appears, from the following passage, to have had a decided leaning to this opinion: "According to some, the difference between axioms and postulates is analogous to that between theorems and problems; the former expressing truths which are self-evident, and from which other propositions may be deduced; the latter, operations which may be easily performed, and by the help of which more difficult constructions may be effected." He afterwards adds, "This account of the distinction between postulates and axioms seems not ill adapted to the division of mathematical propositions into problems and theorems. And indeed, if both postulates and axioms were to be comprehended under either of these names, the innovation would not, in my opinion, afford much ground for censure."‡

In opposition to these very high authorities, I have no hesitation to assert, that it is with the *definitions* of Euclid, and not with the *axioms*, that *postulates* ought to be compared in respect of their logical character and importance;—inasmuch as all the *demonstrations* in plane geometry are ultimately founded on the former, and all the *constructions* which it recognizes as legitimate, may be resolved ultimately into the latter. To this remark it may be added, that according to Euclid's view of the subject, the problems of geometry are not less hypothetical and speculative (or, to adopt the phraseology of some late writers, not less objects of *pure reason*) than the theorems; the possibility of drawing a *mathematical* straight line, and of describing a *mathematical* circle, being assumed in the construction of every problem, in a way quite analogous to that in which the enunciation of a theorem assumes the *existence* of straight lines and of circles corresponding to their *mathematical* definitions. The reasoning, therefore, on which the solution of a problem rests, is not less *demonstrative* than that which is employed in proof of a theorem. Grant the possibility of the three operations described in the postulates, and the correctness of the solution is as mathematically certain, as the truth of any property of the triangle or of the circle. The three postulates of Euclid are, indeed, nothing more than the definitions of a circle and a straight line thrown into a form somewhat different; and a similar remark may be extended to the corresponding distribution of propositions into theorems and problems. Notwithstanding the many conveniences with which this distribution is attended, it was evidently a matter of choice rather than of necessity; all the truths of geometry easily admitting of being moulded into either shape, according to the fancy of the mathematician. As to the *axioms*, there cannot be a doubt (whatever opinion may be entertained of their utility or of their insignificance) that they stand precisely in the same relation to both classes of propositions.*

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* Mathematical Dictionary, Art. *Postulate*.

† Ibid. Art. *Hypothesis*.

‡ Wallisii Opera, Vol. II. pp. 667, 668.

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* In farther illustration of what is said above, on the subject of postulates and of problems, I transcribe with pleasure, a short passage from a learned and interesting memoir, just published, by an author intimately and critically conversant with the classical remains of Greek geometry.

II.

Continuation of the Subject.—How far it is true that all Mathematical Evidence is resolvable into Identical Propositions.

I HAD occasion to take notice, in the first section of the preceding chapter, of a theory with respect to the nature of mathematical evidence, very different from that which I have been now attempting to explain. According to this theory (originally, I believe, proposed by Leibnitz)

"The description of any geometrical line from the data by which it is defined, must always be assumed as possible, and is admitted as the legitimate means of a geometrical construction: it is therefore properly regarded as a *postulate*. Thus, the description of a straight line and of a circle are the postulates of plane geometry assumed by Euclid. The description of the three *conic sections*, according to the definitions of them, must also be regarded as postulates; and though not formally stated like those of Euclid, are in truth admitted as such by Apollonius, and all other writers on this branch of geometry. The same principle must be extended to all superior lines.

"It is true, however, that the properties of such superior lines may be treated of, and the description of them may be assumed in the solution of problems, without an actual delineation of them.—For it must be observed, that no lines whatever, not even the straight line or circle, can be truly represented to the senses according to the strict mathematical definitions; but this by no means affects the theoretical conclusions which are logically deduced from such definitions. It is only when geometry is applied to practice, either in mensuration, or in the arts connected with geometrical principles, that accuracy of delineation becomes important."—See an *Account of the Life and Writings of Robert Simpson*, M. D. By the Rev. William Trail, LL. D. Published by G. and W. Nicol, London, 1812.

we are taught, that all mathematical evidence ultimately resolves into the perception of identity ; the innumerable variety of propositions which *have* been discovered, or which *remain* to be discovered in the science, being only diversified expressions of the simple formula, a = a. A writer of great eminence, both as a mathematician and a philosopher, has lately given his sanction, in the strongest terms, to this doctrine : asserting, that all the prodigies performed by the geometrician are accomplished by the constant repetition of these words,—*the same is the same*, "Le géomêtre avance de supposition en supposition. Et rétournant sa pensée sous mille formes, c'est en répêtant sans cesse, *le même est le même*, qu'il opère tous ses prodiges."

As this account of mathematical evidence is quite irreconcilable with the scope of the foregoing observations, it is necessary, before proceeding farther, to examine its real import and amount ; and what the circumstances are from which it derives that plausibility which it has been so generally supposed to possess.

That all mathematical evidence resolves ultimately into the perception of identity, has been considered by some as a consequence of the commonly-received doctrine, which represents the axioms of Euclid as the *first principles* of all our subsequent reasonings in geometry. Upon this view of the subject I have nothing to offer, in addition to what I have already stated. The argument which I mean to combat at present is of a more subtile and refined nature ; and at the same time involves an admixture of important truth, which contributes not a little to the specious verisimilitude of the conclusion. It is founded on this simple consideration, that the geometrical notions of *equality* and of *coincidence* are the same; and that, even in comparing together spaces of different figures, all our conclusions ultimately lean with their whole weight on the imaginary application of one triangle to another;—the object of which imaginary application is merely to *identify* the two triangles together, in every circumstance connected both with magnitude and figure.*

Of the justness of the assumption on which this argument proceeds, I do not entertain the slightest doubt. Whoever has the curiosity to examine any one theorem in the elements of plane geometry, in which different spaces are compared together, will easily perceive, that the demonstration, when traced back to its first principles, terminates in the fourth proposition of Euclid's first book: a proposition of which the proof rests entirely on a supposed application of the one triangle to the other. In the case of equal triangles which differ in figure, this expedient of ideal superposition cannot be directly and immediately employed to evince their equality; but the demonstration will nevertheless be found to rest at bottom on the same species of evidence. In illustration of this doctrine, I shall only appeal to the thirty-seventh proposition of the first book, in which it is proved that triangles on the same base, and between the same parallels, are equal: a theorem which appears, from a very simple construction, to be only a few steps removed from the fourth of the same book, in which the supposed application of the one triangle to the other, is the only medium of comparison from which their equality is inferred.

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* It was probably with a view to the establishment of this doctrine, that some foreign elementary writers have lately given the name of *identical triangles* to such as agree with each other, both in sides, in angles, and in area. The differences which may exist between them in respect of place, and of relative position (differences which do not at all enter into the reasonings of the geometer) seem to have been considered as of so little account in discriminating them as separate objects of thought, that it has been concluded they only form *one and the same triangle*, in the contemplation of the logician.

This idea is very explicitly stated, more than once, by Aristotle: *ἴσα ὧν τὸ ποσὸν ἕν*. "Those things are equal whose quantity is the same;" (Met. iv. c. 15.) and still more precisely in these remarkable words, *ἐν τούτοις ἡ ἰσότης ἑνότης*; "In mathematical quantities, equality is identity." (Met. x. c. 3.

For some remarks on this last passage, See Note (F.)

In general, it seems to be almost self-evident, that the equality of two spaces can be demonstrated only by showing either that the one might be applied to the other, so that their boundaries should exactly coincide; or that it is possible, by a geometrical construction, to divide them into compartments, in such a manner, that the sum of parts in the one may be proved to be equal to the sum of parts in the other, upon the principle of superposition. To devise the easiest and simplest constructions for attaining this end, is the object to which the skill and invention of the geometer is chiefly directed.

Nor is it the geometer alone who reasons upon this principle. If you wish to convince a person of plain understanding, who is quite unacquainted with mathematics, of the truth of one of Euclid's theorems, it can only be done by exhibiting to his eye, operations exactly analogous to those which the geometer presents to the understanding. A good example of this occurs in the sensible or experimental illustration which is sometimes given of the forty-seventh proposition of Euclid's first book. For this purpose, a card is cut into the form of a right angled triangle, and square pieces of card are adapted to the different sides; after which, by a simple and ingenious contrivance, the different squares are so dissected, that those of the two sides are made to cover the same space with the square of the hypothenuse. In truth, this mode of comparison by a supposition, actual or ideal, is the only test of equality which it is possible to appeal to; and it is from this (as seems from a passage in Proclus to have been the opinion of Apollonius) that in point of logical rigour, the *definition* of geometrical equality should have been taken.* The subject is discussed at great length, and with much acuteness, as well as learning, in one of the mathematical lectures of Dr. Barrow; to which I must refer those readers who may wish to see it more fully illustrated.

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* I do not think, however, that it would be fair, on this account, to censure Euclid for the arrangement which he has adopted, as he has thereby most ingeniously and dexterously contrived to keep out of the view of the student some very puzzling questions, to which it is not possible to give a satisfactory answer till a considerable progress has been made in the elements. When it is stated in the form of a self-evident truth, that magnitudes which coincide, or which exactly fill the same space, are equal to one another; the beginner readily yields his assent to the proposition; and this assent, without going any farther, is all that is required in any of the demonstrations of the first six books, whereas, if the proposition were converted into a definition, by saying, "Equal magnitudes are those which coincide, or which exactly fill the same space;" the question would immediately occur, Are *no* magnitudes equal, but those to which this test of equality can be applied? Can the relation of equality not subsist between magnitudes which differ from each other in figure? In reply to this question, it would be necessary to explain the definition by adding, That those magnitudes likewise are said to be equal, which are capable of being divided or dissected in such a manner that the parts of the one may severally coincide with the parts of the other;—a conception much too refined and complicated for the generality of students at their first outset; and which, if it were fully and clearly apprehended, would plunge them at once into the profound speculation concerning the comparison of rectilinear with curvilinear figures

I am strongly inclined to suspect, that most of the writers who have maintained that all mathematical evidence resolves ultimately into the perception of identity, have had a secret reference, in their own minds, to the doctrine just stated; and that they have imposed on themselves, by using the words *identity* and *equality* as literally synonymous and convertible terms. This does not seem to be at all consistent, either in point of expression or of fact, with sound logic. When it is affirmed (for instance) that "if two straight lines in a circle intersect each other, the rectangle contained by the segments of the one is equal to the rectangle contained by the segments of the other;" can it with any propriety be said, that the relation between these rectangles may be expressed by the formula $a = a$? Or, to take a case yet stronger, when it is affirmed, that "the area of a circle is equal to that of a triangle having the circumference for its base, and the radius for its altitude;" would it not be an obvious paralogism to infer from this proposition, that the triangle and the circle are one and the same thing? In this last instance, Dr. Barrow himself has thought it necessary, in order to reconcile the language of Archimedes with that of Euclid, to have recourse to a scholastic distinction between *actual* and *potential coincidence;* and, therefore, if we are to avail ourselves of the principle of *superposition*, in defence of the fashionable theory concerning mathematical evidence, we must, I apprehend, introduce a correspondent distinction between *actual and potential identity.**

That I may not be accused, however, of misrepresenting the opinion which I am anxious to refute, I shall state it in the words of an author, who has made it the subject of a particular dissertation; and who appears to me to have done as much justice to his argument as any of its other defenders.

"Omnes mathematicorum propositiones sunt identicæ, et repræsentantur hac formula, a = a. Sunt veritates identicæ, sub varia forma expressæ, imo ipsum, quod dicitur contradictionis principium, vario modo enunciatum et involutum; siquidem omnes hujus generis propositiones reverâ in eo continentur. Secundum nostram autem intelligendi facultatem ea est propositionum differentia, quod quædam longa ratiociniorum serie, alia autem breviore via, ad primum omnium principium reducantur, et in illud resolvantur. Sic v. g. propositio 2 + 2 = 4 statim huc ce-dit $1+1+1+1=1+1+1+1$; i. e. idem est idem; et proprie loquendo, hoc modo enunciari debet. Si contingat, adesse vel existere quatuor entia, tum existunt quatuor entia; nam de existentia non agunt geometræ, sed ea hypothetice tantum subintelligitur. Inde summa oritur certitudo ratiocinia perspicienti; observat nempe idearum identitatem; et hæc est evidentia assensum immediate cogens, quam mathematicam aut geometricam vocamus. Mathesi tamen sua natura priva non est et propria; oritur etenim ex identitatis perceptione, quæ locum habere potest, etiamsi ideæ non repræsentent extensum."*

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* "Cum demonstravit Archimedes circulum æquari rectangulo triangulo cujus basis radio circuli, cathetus peripheriæ exæquetur, nil ille, siquis propius attendat, aliud quicquam quam aream circuli ceu polygoni regularis indefinite multa latera habentis, in tot dividi posse minutissima triangula, quæ totidem exilissimis dicti trianguli trigonis æquentur; eorum verò triangulorum æqualitas é sola congruentia demonstratur in elementis. Unde consequenter Archimedes circuli cum triangulo (sibi quantumvis dissimili) congruentiam demonstravit.——Ita congruentiæ nihil obstat figurarum dissimilitudo; verùm seu similes sive dissimiles sint, modò æquales, semper poterunt, semper posse debebunt congruere. Igitur octavum axioma vel nullo modo, conversum valet, aut universaliter converti potest; nullo modo, si quæ isthic habetur congruentia designet *actualem congruentiam*; universim, si de *potentiali* tantùm accipiatur."—*Lectiones Mathematicæ*, Sect. V.

With respect to this passage I have only to remark, (and the same thing is observable of every other attempt which has been made to support the opinion in question,) that the author confounds two things essentially different; —the nature of the *truths* which are the objects of a science, and the nature of the *evidence* by which these truths are established. Granting, for the sake of argument, that all mathematical propositions may be represented by the formula $a = a$, it would not therefore follow, that every step of the reasoning leading to these conclusions, was a proposition of the same nature; and that to feel the full force of a mathematical demonstration, it is sufficient to be convinced of this maxim, that *every thing may be truly predicated of itself;* or, in plain English, that *the same is the same.* A paper written in cipher, and the interpretation of that paper by a skilful decipherer, may, in like manner, be considered as, to all intents and purposes, one and the same thing. They are so, in fact, just as much as one side of an algebraical equation is the same thing with the other. But does it therefore follow, that the whole evidence upon which the art of deciphering proceeds, resolves into the perception of identity?

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* The above extract (from a dissertation printed at Berlin in 1764) has long had a very extensive circulation in this country, in consequence of its being quoted by Dr. Beattie, in his Essay on Truth, (see p. 221, 2d edit.) As the learned author of the essay has not given the slightest intimation of his own opinion on the subject, the doctrine in question has, I suspect, been considered as in some measure sanctioned by his authority. It is only in this way that I can account for the facility with which it has been admitted by so many of our northern logicians.

It may be fairly questioned too, whether it can, with strict correctness, be said even of the simple arithmetical equation $2 + 2 = 4$, that it may be represented by the formula $a = a$. The one is a proposition asserting *the equivalence of two different expressions;*—to ascertain which equivalence may, in numberless cases, be an object of the highest importance. The other is altogether unmeaning and nugatory, and cannot, by any possible supposition, admit of the slightest application of a practical nature. What opinion then shall we form of the proposition $a = a$, when considered as the representative of such a *formula* as the binomial theorem of Sir Isaac Newton? When applied to the equation $2 + 2 = 4$ (which from its extreme simplicity and familiarity is apt to be regarded in the light of an axiom) the paradox does not appear to be so manifestly extravagant; but, in the other case, it seems quite impossible to annex to it any meaning whatever.

I should scarcely have been induced to dwell so long on this theory of Leibnitz concerning mathematical evidence, if I had not observed among some late logicians (particularly among the followers of Condillac) a growing disposition to extend it to all the different sorts of evidence resulting from the various employments of our reasoning powers. Condillac himself states his own opinion on this point with the most perfect confidence. *L'évidence de raison consiste uniquement dans l'identité :* c'est ce que nous avons démontré. Il faut que cette vérité soit bien simple pour avoir échappé à tous les philosophes, quoiqu' ils eussent tant d'intérêt à s'assurer de l'evidence, dont ils avoient continuellement le mot dans la bouche."*

The *demonstration* here alluded to is extremely concise ; and if we grant the two *data* on which it proceeds, must be universally acknowledged to be irresistible. The first is, " That the evidence of every mathematical *equation* is that of identity :" The second, " That what are called, in the other sciences, *propositions* or *judgments*, are, at bottom, precisely of the same nature with *equations*."—But it is proper, on this occasion, to let our author speak for himself.

" Mais, dira-t-on, c'est ainsi qu'on raisonne en mathematiques, ou le raisonnement se fait avec des équations. En sera-t-il de même dans les autres sciences, où le raisonnement se fait avec des propositions ? Je réponds qu' *équations, propositions, jugemens*, sont au fond la même chose, et que par consequent on raisonne de la même manière dans toutes les sciences."†

Upon this demonstration I have no comment to offer. The truth of the first assumption has been already examined at sufficient length ; and the second (which is only

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* La Logique, Chap. IX. † Ibid. Chap. VIII.

Locke's very erroneous account of *judgment*, stated in terms incomparably more exceptionable) is too puerile to admit of refutation. It is melancholy to reflect, that a writer who, in his earlier years, had so admirably unfolded the mighty influence of language upon our speculative conclusions, should have left behind him, in one of his latest publications, so memorable an illustration of his own favourite doctrine.

It was manifestly with a view to the more complete establishment of the same theory, that Condillac undertook a work, which has appeared since his death, under the title of *La Langue des Calculs;* and which, we are told by the editors, was only meant as a prelude to other labours, more interesting and more difficult. From the circumstances which they have stated, it would seem that the intention of the author was to extend to all the other branches of knowledge, inferences similar to those which he has here endeavoured to establish with respect to mathematical calculations ; and much regret is expressed by his friends, that he had not lived to accomplish a design of such incalculable importance to human happiness. I believe I may safely venture to assert, that it was fortunate for his reputation he proceeded no farther ; as the sequel must, from the nature of the subject, have afforded, to every competent judge, an experimental and palpable proof of the vagueness and fallaciousness of those views by which the undertaking was suggested. In his posthumous volume, the mathematical precision and perspicuity of his details appear to a superficial reader to reflect some part of their own light on the general reasonings with which they are blended ; while, to judges, these reasonings come recommended with many advantages, and with much additional authority, from their coincidence with the doctrines of the Leibnitzian school.

It would probably have been not a little mortifying to this most ingenious and respectable philosopher, to have discovered, that, in attempting to generalize a very celebrated theory of Leibnitz, he had stumbled upon an obsolete conceit, started in this island upwards of a century before. "When a man reasoneth, (says Hobbes) he does nothing else but conceive a sum total, from addition of parcels ; or conceive a remainder from subtraction of one sum from another ; which (if it be done by words) is conceiving of the consequence of the names of all the parts, to the name of the whole ; or from the names of the whole and one part, to the name of the other part. These operations are not incident to numbers only, but to all manner of things that can be added together, and taken one out of another. In sum, in what matter soever there is place for addition and subtraction, there also is place for reason ; and where these have no place, there reason has nothing at all to do.

"Out of all which we may define what that is which is meant by the word *reason*, when we reckon it amongst the faculties of the mind. For *reason*, in this sense, is nothing but *reckoning* (that is, adding and subtracting) of the consequences of general names agreed upon, for the *marking* and *signifying* of our thoughts ;—I say *marking* them, when we reckon by ourselves ; and *signifying*, when we demonstrate, or approve our reckonings to other men."[*]

Agreeably to this definition, Hobbes has given to the first part of his elements of philosophy, the title of COMPUTATIO, sive LOGICA; evidently employing these two words as precisely synonymous. From this tract I shall quote a short paragraph, not certainly on account of its intrinsic value, but in consequence of the interest which it derives from its coincidence with the speculations of some of our contemporaries. I transcribe it from the Latin edition, as the antiquated English of the author is apt to puzzle readers not familiarized to the peculiarities of his philosophical diction.

"Per ratiocinationem autem intelligo computationem. Computare vero est *plurium rerum simul additarum summam colligere, vel unâ re ab aliâ detractâ, cognoscere residuum.* Ratiocinari igitur idem est quod *addere* et *subtrahere*, vel si quis adjungat his *multiplicare* et *dividere*, non abnuam, cum *multiplicatio* idem sit quod æqualium *additio, diviso* quod æqualium quoties fieri potest *subtractio.* Recidit itaque ratiocinatio omnis ad duas operationes animi, *additionem* et *subtractionem.*"[†] How wonderfully does this jargon agree with the assertion of Condillac, that all equations are propositions, and all propositions equations!

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[*] Leviathan, Chap. v.

[†] The *Logica* of Hobbes has been lately translated into French under the title of *Calcul ou Logique*, by M. Destutt-Tracy. It is annexed to the third volume of this *Elémens d'Idéologie*, where it is honoured with the highest eulogies by the ingenious translator. "L'ouvrage en masse (he observes in one passage) mérite d'être regardé comme un produit precieux des méditations de Bacon et de Descartes sur le systême d'Aristote, et comme le germe des progrés ultérieures de la science." *Disc. Prel.* p. 117.

These speculations, however, of Condillac and of Hobbes relate to reasoning in general; and it is with mathematical reasoning alone, that we are immediately concerned at present. That the peculiar evidence with which *this* is accompanied is not resolvable into the perception of identity, has, I flatter myself, been sufficiently proved in the beginning of this article; and the plausible extension by Condillac of the very same theory to our reasonings in all the different branches of moral science, affords a strong additional presumption in favour of our conclusion.

From this long digression, into which I have been insensibly led by the errors of some illustrious foreigners concerning the nature of mathematical demonstration, I now return to a further examination of the distinction between sciences which rest ultimately on facts, and those in which *definitions* or *hypotheses* are the sole principles of our reasonings.

III.

Continuation of the Subject.—Evidence of the Mechanical Philosophy, not to be confounded with that which is properly called Demonstrative or Mathematical.—Opposite Error of some late Writers.

NEXT to geometry and arithmetic, in point of evidence and certainty, is that branch of general physics which is now called mechanical philosophy;—a science in which the progress of discovery has been astonishingly rapid, during the course of the last century: and which, in the systematical concatenation and filiation of its elementary principles, exhibits every day more and more of that logical simplicity and elegance which we admire in the works of the Greek mathematicians. It may, I think, be fairly questioned, whether, in this department of knowledge, the affectation of mathematical method has not been already carried to an excess; the essential distinction between mechanical and mathematical truths being, in many of the physical systems which have lately appeared on the Continent, studiously kept out of the reader's view, by exhibiting both, as nearly as possible, in the same form. A variety of circumstances, indeed, conspire to identify in the imagination, and, of consequence, to assimilate in the mode of their statement, these two very different classes of propositions; but as this assimilation (beside its obvious tendency to involve experimental facts in metaphysical mystery) is apt occasionally to lead to very erroneous logical conclusions, it becomes the more necessary, in proportion as it arises from a *natural* bias, to point out the causes in which it has originated, and the limitations with which it ought to be understood.

The following slight remarks will sufficiently explain my general ideas on this important article of logic.

1. As the study of the mechanical philosophy is, in a great measure, inaccessible to those who have not received a regular mathematical education, it commonly happens, that a taste for it is, in the first instance, grafted on a previous attachment to the researches of pure or ab-

stract mathematics. Hence a natural and insensible transference to physical pursuits, of mathematical habits of thinking; and hence an almost unavoidable propensity to give to the former science, that systematical connexion in all its various conclusions, which, from the nature of its first principles, is essential to the latter, but which can never belong to any science which has its foundations laid in facts collected from experience and observation.

2. Another circumstance, which has co-operated powerfully with the former in producing the same effect, is that proneness to simplification which has misled the mind, more or less, in all its researches; and which, in natural philosophy, is peculiarly encouraged by those beautiful analogies which are observable among different physical phenomena—analogies, at the same time, which, however pleasing to the fancy, cannot always be resolved by our reason into one general law. In a remarkable analogy, for example, which presents itself between the equality of action and reaction in the collision of bodies, and what obtains in their mutual attractions, the coincidence is so perfect, as to enable us to comprehend all the various facts in the same theorem: and it is difficult to resist the temptation which it seems to offer to our ingenuity, of attempting to trace it, in both cases, to some common principle. Such trials of theoretical skill I would not be understood to censure indiscriminately; but, in the present instance, I am fully persuaded, that it is at once more unexceptionable in point of sound logic, and more satisfactory to the learner to establish the fact, in particular cases, by an appeal to experiment; and to state the law of action and reaction in the collision of

bodies, as well as that which regulates the mutual tendencies of bodies towards each other, merely as general rules which have been obtained by induction, and which are found to hold invariably as far as our knowledge of nature extends.[*]

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[*] It is observed by Mr. Robison, in his Elements of Mechanical Philosophy, that "Sir Isaac Newton, in the general scholium on the laws of motion, seems to consider the equality of action and reaction, as an axiom deduced from the relations of ideas. *But this* (says Mr. Robison) *seems doubtful*. Because a magnet causes the iron to approach towards it, it does not appear that we *necessarily* suppose that iron also attracts the magnet." In confirmation of this he remarks, that notwithstanding the previous conclusions of Wallis, Wren, and Huyghens, about the mutual, equal, and contrary action of solid bodies in their collisions, "Newton himself only *presumed* that, because the sun attracted the planets, these also attracted the sun; and that he is at much pains to point out phenomena to astronomers by which this may be proved, when the art of observation shall be sufficiently perfected." Accordingly, Mr. Robison, with great propriety, contents himself with stating this third law of motion, as a fact "with respect to all bodies on which we can make experiment or observation fit for deciding the question."

In the very next paragraph, however, he proceeds thus: "As it is an universal law, we cannot rid ourselves of the persuasion that it depends on some general principle which influences all the matter in the universe;—to which observation he subjoins a conjecture or hypothesis concerning the nature of this principle or cause. For an outline of his theory I must refer to his own statement. (See *Elements of Mechanical Philosophy*, Vol. I. pp. 124, 125, 126.)

Of the fallaciousness of synthetical reasonings concerning physical phenomena, there cannot be a stronger proof, than the diversity of opinion among the most eminent philosophers with respect to the species of evidence on which the third law of motion rests. On this point, a direct opposition may be remarked in the views of Sir Isaac Newton, and of his illustrious friend and commentator, Mr. Maclaurin; the former seeming to lean to the supposition, that it is a corollary deducible *a priori* from abstract principles; while the latter (manifestly considering it as the effect of an arbitrary arrangement) strongly recommends it to the attention of those who delight in the investigation of final causes.[*] My own idea is, that, in the

[*] Account of Newton's Philosophical Discoveries. Book II. Chap 2. § 2.

An additional example may be useful for the illustration of the same subject. It is well known to be a general principle in mechanics, that when, by means of any machine, two heavy bodies counterpoise each other, and are then made to move together, the quantities of motion with which one descends, and the other ascends perpendicularly, are equal. This equilibrium bears such a resemblance to the case of two moving bodies stopping each other, when they meet together with equal quantities of motion, that, in the opinion of many writers, the cause of an equilibrium in the several machines is sufficiently explained, by remarking, "that a body always loses as much motion as it communicates." Hence it is inferred, that when two heavy bodies are so circumstanced, that one cannot descend without causing the other to ascend at the same time, and with the same quantity of motion, both of these bodies must necessarily continue at rest. But this reasoning, however plausible it may seem to be at first sight, is by no means satisfactory; for (as Dr. Hamilton has justly observed[*]) when we say, that one body *communicates* its motion to another, we must suppose the motion to exist, *first* in the one, and *afterwards* in the other; whereas, in the case of the machine, the ascent of the one body cannot, by any conceivable refinement, be ascribed to a communication of motion from the body which is descending at the same moment; and, therefore, (admitting the truth of the general law which

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present state of our knowledge, it is at once more safe and more logical, to consider it merely as an experimental truth; without venturing to decide positively on either side of the question. As to the doctrine of final causes, it fortunately stands in need of no aid from such dubious speculations.

[*] See Philosophical Essays, by Hugh Hamilton, D. D. Professor of Philosophy in the University of Dublin, p. 135. et seq. 3d edit. (London, 1772)

obtains in the collision of bodies) we might suppose, that in the machine, the superior weight of the heavier body would overcome the lighter, and cause it to move upwards with the same quantity of motion with which itself moves downwards. In perusing a pretended demonstration of this sort, a student is dissatisfied and puzzled; not from the difficulty of the subject, which is obvious to every capacity, but from the illogical and inconclusive reasoning to which his assent is required.*

3. To these remarks it may be added, that even when one proposition in natural philosophy is logically deducible from another, it may frequently be expedient, in communicating the elements of the science, to illustrate and confirm the consequence, as well as the principle, by experiment. This I should apprehend to be proper, wherever a consequence is inferred from a principle less familiar and intelligible than itself; a thing which must occasionally happen in physics, from the complete incorporation (if I may use the expression) which, in modern times, has taken place between physical truths, and the discover-

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* The following observation of Dr. Hamilton places this question in its true point of view. "However, as the theorem above-mentioned is a very elegant one, it ought certainly to be taken notice of in every treatise of mechanics, and may serve as a very good *index* of an *æquilibrium* in all machines; but I do not think that we can from thence, or from any one general principle, explain the nature and effects of all the mechanic powers in a satisfactory manner."

To the same purpose, it is remarked by Mr. Maclaurin, that "though it be useful and agreeable, to observe how uniformly this principle prevails in engines of evey sort, throughout the whole of mechanics, in all cases where an *æquilibrium* takes place; yet that it would not be right to rest the evidence of so important a doctrine upon a proof of this kind only." *Account of Newton's Discoveries*, B. II. c. 3.

ies of mathematicians. The necessary effect of this incorporation was, to give to natural philosophy a mathematical form, and to systematize its conclusions, as far as possible, agreeably to rules suggested by mathematical method.

In pure mathematics, where the truths which we investigate are all coexistent in point of time, it is universally allowed, that one proposition *is said* to be a consequence of another, only with a reference to our established arrangements. Thus all the properties of the circle might be as rigorously deduced from any one general property of the curve, as from the equality of the radii. But it does not therefore follow, that all these arrangements would be equally convenient; on the contrary, it is evidently useful, and indeed necessary, to lead the mind, as far as the thing is practicable, from what is simple to what is more complex. The misfortune is, that it seems impossible to carry this rule universally into execution: and, accordingly, in the most elegant geometrical treatises which have yet appeared, instances occur, in which consequences are deduced from principles more complicated than themselves. Such inversions, however, of what may justly be regarded as the natural order, must always be felt by the author as a subject of regret; and, in proportion to their frequency, they detract both from the beauty and from the didactic simplicity of his general design.

The same thing often happens in the elementary doctrines of natural philosophy. A very obvious example occurs in the different demonstrations given by writers on mechanics, from the resolution of forces, of the fundamental proposition concerning the lever;—demonstrations in which the proposition, even in the simple case when the directions of the forces are supposed to be parallel, is inferred from a process of reasoning involving one of the most refined principles employed in the mechanical philosophy. I do not object to this arrangement as illogical; nor do I presume to say that it is injudicious.* I would only suggest the propriety, in such instances, of confirming and illustrating the conclusion, by an appeal to experiment; an appeal which, in natural philosophy, possesses an authority equal to that which is generally, but very improperly, considered as a mathematical demonstration of physical truths. In pure geometry, no reference to the senses can be admitted, but in the way of illustration; and any such reference, in the most trifling step of a demonstration, vitiates the whole. But, in natural philosophy, all our reasonings must be grounded on principles for which no evidence but that of sense can be obtained; and the propositions which we establish, differ from each other only as they are deduced from such principles immediately, or by the intervention of a mathematical demonstration. An experimental proof, therefore, of any particular physical truth, when it can be conveniently obtained, although it may not always be the most elegant or the most expedient way of introducing it to the knowledge of the student, is as rigorous and as satisfactory as any other; for the intervention of a process of mathematical reasoning can never bestow on our conclusions a greater degree of certainty than our principles possessed.*

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* In *some* of these demonstrations, however, there is a logical inconsistency so glaring, that I cannot resist the temptation of pointing it out here, as a good instance of that undue predilection for mathematical evidence, in the exposition of physical principles, which is conspicuous in many elementary treatises. I allude to those demonstrations of the property of the lever, in which, after attempting to prove the general theorem, on the supposition that the directions of the forces meet in a point, the same conclusion is extended to the simple case in which these directions are parallel, by the *fiction* (for it deserves no other name) of conceiving parallel lines to meet at an infinite distance, or to form with each other an angle infinitely small. It is strange, that such a proof should ever have been thought more satisfactory than the direct evidence of our senses. How much more reasonable and pleasing to begin with the simpler case (which may be easily brought to the test of experiment) and then to deduce from it, by the resolution of forces, the general proposition? Even Dr Hamilton himself, who has treated of the mechanical powers with much ingenuity, seems to have imagined, that by demonstrating the theorem, in all its cases, from the composition and resolution of forces alone, he had brought the whole subject within the compass of pure geometry. It could scarcely, however, (one should think) have escaped him, that every valid demonstration of the composition of forces must necessarily assume as a *fact*, that "when a body is acted upon by a force parallel to a straight line given in position, this force has no effect, either to accelerate or to retard the progress of the body towards that line." Is not this fact much further removed from common observation than the fundamental property of the lever, which is familiar to every peasant, and even to every savage? And yet the same author objects to the demonstration of Huyghens, that it depends upon a principle, *which* (he says) *ought not to be granted on this occasion*,—that "when two equal bodies are placed on the arms of a lever, that which is furthest from the *fulcrum* will preponderate."

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* Several of the foregoing remarks were suggested by certain peculiarities of opinion relative to the distinct provinces of experimental and of mathematical evidence in the study of physics, which were entertained by my learned and excellent friend, the late Mr. Robison. Though himself a most enlightened and zealous advocate for the doctrine of final causes, he is well known to have formed his scientific taste chiefly upon the mechanical philosophers of the Continent, and, in consequence of this circumstance, to have undervalued *experiment*, wherever a possibility offered of introducing mathematical, or even metaphysical reasoning. Of this bias various traces occur, both in his Elements of Mechanical Philosophy, and in the valuable articles which he furnished to the Encyclopædia Britannica.

I have been led to enlarge on these topics by that unqualified application of mathematical method to physics, which has been fashionable for many years past among foreign writers; and which seems to have originated chiefly in the commanding influence which the genius and learning of Leibnitz have so long maintained over the scientific taste of most European nations.* In an account, late-

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* The following very extraordinary passage occurs in a letter from Leibnitz to Mr. Oldenburg.

"Ego id agere constitui, ubi primum otium nactus ero, ut rem omnem mechanicam reducam ad puram geometriam; problemataque circa elateria, et aquas et pendula, et projecta, et solidorum resistentiam, et frictiones, &c. definiam. Quæ hactenus attigit nemo. Credo autem rem omnem nunc esse in potestate; ex quo circa regulas motuum mihi penitus perfectis demonstrationibus satisfeci; neque quicquam amplius in eo genere desidero. Tota autem res, quod mireris, pendet ex axiomate metaphysico pulcherrimo, quod non minoris momenti est circa motum, quam hoc, totum esse majus parte, circà magnitudinem." (*Wallisii Opera*, Vol. III. p. 633.)

The *beautiful metaphysical axiom* here referred to by Leibnitz, is plainly the principle of *the sufficient reason;* and it is not a little remarkable, that the highest praise which he had to bestow upon it was, to compare it to Euclid's axiom, "That the whole is greater than its part." Upon this principle of *the sufficient reason*, Leibnitz, as is well known, conceived that a complete system of physical science might be built, as he thought the whole of mathematical science resolvable into the principles of identity and of contradiction.—By the first of these principles (it may not be altogether superfluous to add) is to be understood the maxim, "Whatever is, is;" By the second, the maxim, that "It is impossible for the same thing to be, and not to be:"—two maxims which, it is evident, are only different expressions of the same proposition.

In the remarks made by Locke on the logical inutility of *mathematical* axioms, and on the logical danger of assuming *metaphysical* axioms as the principles of our reasonings in other sciences, I think it highly probable, that he had a secret reference to the philosophical writings and epistolary correspondence of Leibnitz. This appears to me to furnish a key to some of Locke's observations, the scope of which Dr. Reid professes his inability to discover. One sentence, in particular, on which he has animadvert-ly published, of the Life and Writings of Dr. Reid, I have taken notice of some further inconveniencies resulting from it, still more important than the introduction of

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ed with some severity, is, in my opinion, distinctly pointed at the letter to Mr. Oldenburg, quoted in the beginning of this note.

"Mr. Locke farther says (I borrow Dr. Reid's own statement) that maxims are not of use to help men forward in the advancement of the sciences, or new discoveries of yet unknown truths: that Newton in the discoveries he has made in his never enough to be admired book, has not been assisted by the general maxim, whatever is, is; or the whole is greater than a part, or the like."

As the Letter to Oldenburg is dated in 1676, (twelve years before the publication of the Essay on Human Understanding) and as Leibnitz expresses a desire that it may be communicated to Mr. Newton, there can scarcely be a doubt that Locke had read it; and it reflects infinite honour on his sagacity, that he seems, at that early period, to have foreseen the extensive influence which the errors of this illustrious man were so long to maintain over the opinions of the learned world. The truth is, that even then he prepared a reply to some reasonings which at the distance of a century, were to mislead, both in physics and in logic, the first philosophers in Europe.

If these conjectures be well founded, it must be acknowledged that Dr. Reid has not only failed in his defence of *maxims* against Locke's attack; but that he has totally misapprehended the aim of Locke's argument.

"I answer (says he, in the paragraph immediately following that which was quoted above,) the first of these maxims (whatever is, is) is an identical proposition, of no use in mathematics or in any other science. The second (that the whole is greater than a part) is often used by Newton, and by all mathematicians, and many demonstrations rest upon it. In general, Newton, as well as all other mathematicians, grounds his demonstrations of mathematical propositions upon the axioms laid down by Euclid, or upon propositions which have been before demonstrated by help of these axioms.

"But it deserves to be particularly observed, that Newton, intending in the third book of his *Principia* to give a more scientific form to the physical part of astronomy, which he had at first composed in a popular form, thought proper to follow the example of Euclid, and to lay down first, in what he calls *Regulæ Philosophandi*, and in his *Phenomena*, the first principles which he assumes in his reasoning.

an unsound logic into the elements of natural philosophy; in particular, of the obvious tendency which it has to withdraw the attention from that unity of design which it is the noblest employment of philosophy to illustrate, by disguising it under the semblance of an eternal and necessary order, similar to what the mathematician delights to trace among the mutual relations of quantities and figures. The consequence has been, (in too many physical systems,) to level the study of nature, in point of moral interest, with the investigations of the algebraist;—an effect too, which has taken place most remarkably, where, from the sublimity of the subject, it was least to be expected,—in the application of the mechanical philosophy to the phenomena of the heavens. But on this very extensive and important topic, I must not enter at present.

In the opposite extreme to the error which I have now been endeavouring to correct, is a paradox which was broached, about twenty years ago, by the late ingenious Dr. Beddoes; and which has since been adopted by some writers whose names are better entitled, on a question of this sort, to give weight to their opinions.* By the partisans of this new doctrine it seems to be immagined, that—so far from physics being a branch of mathema-

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"Nothing, therefore, could have been more unluckily adduced by Mr. Locke to support his aversion to first principles, than the example of Sir Isaac Newton." (*Essays on the Int. Powers*, pp. 647, 648, 4to edit.)

* I allude here more particularly to my learned friend, Mr. Leslie, whose high and justly merited reputation, both as a mathematician and an experimentalist, renders it indispensably necessary for me to take notice of some fundamental logical mistakes which he appears to me to have committed in the course of those ingenious excursions, in which he occasionally indulges himself, beyond the strict limits of his favourite studies.

tics,—mathematics, and more particularly geometry, is, in reality, only a branch of physics. "The mathematical sciences (says Dr. Beddoes) are sciences of experiment and observation, founded solely on the induction of particular facts; as much so as mechanics, astronomy, optics, or chemistry. In the kind of evidence there is no difference; for it originates from perception in all these cases alike; but mathematical experiments are more simple, and more perfectly within the grasp of our senses, and our perceptions of mathematical objects are clearer."*

A doctrine essentially the same, though expressed in terms not quite so revolting, has been lately sanctioned by Mr. Leslie; and it is to *his* view of the argument that I mean to confine my attention at present. "The whole structure of geometry (he remarks) is grounded on the simple comparison of triangles; and all the fundamental theorems which relate to this comparison, derive their evidence from the *mere* superposition of the triangles themselves; a mode of proof which, in reality, is nothing but an ultimate appeal, though of the easiest and most familiar kind, to external observations."* And, in another passage: "Geometry, like the other sciences which are not concerned about the operations of mind, rests ultimately on external observations. But those ultimate facts are so few, so distinct and obvious, that the subsequent train of reasoning is safely pursued to unlimited extent, without ever appealing *again* to the evidence of the senses."†

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* Into this train of thinking, Dr. Beddoes informs us, he was first led by Mr. Horne Tooke's speculations concerning language. "In whatever study you are engaged, to leave difficulties behind is distressing: and when these difficulties occur at your very entrance upon a science, professing to be so clear and certain as geometry, your feelings become still more uncomfortable; and you are dissatisfied with your own powers of comprehension. I therefore think it due to the author of ΕΠΕΑ ΠΤΕΡΟΕΝΤΑ, to acknowledge my obligations to him for relieving me from this sort of distress. For although I had often made the attempt, I could never solve certain difficulties in Euclid, till my reflections were revived and assisted by Mr. Tooke's *discoveries*," (See *Observations on the Nature of Demonstrative Evidence*, London, 1793, pp. 5, and 15.)

Before proceeding to make any remarks on this theory, it is proper to premise, that it involves two separate considerations, which it is of material consequence to distinguish from each other. The first is, that extension and figure (the subjects of geometry) are qualities of body which are made knôwn to us by our external senses alone, and which actually fall under the consideration of the natural philosopher, as well as of the mathematician. The second, that the whole fabric of geometrical science rests on the comparison of triangles, in forming which comparison, we are ultimately obliged to appeal (in the sàme manner as in establishing the first principles of physics) to a sensible and experimental proof.

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* Elements of Geometry and of Geometrical Analysis, &c. By Mr. Leslie. Edinburgh, 1809.

The assertion that *the whole* structure of geometry is founded on the comparison of triangles, is expressed in terms too unqualified. D'Alembert has mentioned another principle as not less fundamental, the measurement of angles by circular arches. "Les propositions fondamentales de géométrie peuvent être réduites à deux; la mesure des angles par les arcs de cercle, et le principe de la superposition." (*Elemens de Philosophie*, Art. *Gèomètrie.*) The same writer, however, justly observes, in another part of his works, that the measure of angles by circular arches, is itself dependent on the principle of superposition; and that consequently, however extensive and important in its application, it is entitled only to rank with what he calls *principles of a second order*. "La mesure des angles par les arcs de cercle décrit de leur sommet, est elle-même dépendante du principe de la superposition. Car quand on dit que la mesure d'un angle est l'arc circulaire décrit de son sommet, on veut dire que si deux angles sont égaux, les angles décrits de leur sommet à même rayon, seront égaux; vérité qui se démontre par le principe de la superposition, comme tout géometre tant soit peu initié dans cette science le sentira facilement." (*Eclaircissemens sur les Elémens de Philosophie*, § IV.)

Instead, therefore, of saying that the whole structure of geometry is grounded on the comparison of triangles, it would be more correct to say, that it is grounded on the principle of superposition.

† Elements of Geometry, and of Geometrical Analysis, p. 453

1. In answer to the first of these allegations, it might perhaps be sufficient to observe, that in order to identify two sciences, it is not enough to state, that they are both conversant about the same objects; it is necessary farther to show, that, in both cases, these objects are considered in the same point of view, and give employment to the same faculties of the mind. The poet, the painter, the gardener, and the botanist, are all occupied in various degrees and modes, with the study of the vegetable kingdom: yet who has ever thought of confounding their several pursuits under one common name? The natural historian, the civil historian, the moralist, the logician, the dramatist, and the statesman, are all engaged in the study of man, and of the principles of human nature; yet how widely discriminated are these various departments of science and of art! how different are the kinds of evidence on which they respectively rest; how different the intellectual habits which they have a tendency to form! Indeed, if this mode of generalization were to be admitted as legitimate, it would lead us to blend all the objects of science into one and the same mass; inasmuch as it is by the same impressions on our external senses, that our intellectual

faculties are, in the first instance, roused to action, and all the first elements of our knowledge unfolded.

In the instance, however, before us, there is a very remarkable speciality, or rather singularity, which renders the attempt to identify the objects of geometrical and of physical science, incomparably more illogical than it would be to classify poetry with botany, or the natural history of man with the political history of nations. This speciality arises from certain peculiarities in the metaphysical nature of those *sensible qualities* which fall under the consideration of the geometer: and which led me, in a different work, to distinguish them from other sensible qualities (both primary and secondary,) by bestowing on them the title of *mathematical affections of matter.** Of these mathematical affections (*magnitude* and *figure*,) our first notions are, no doubt, derived (as well of hardness, softness, roughness, and smoothness) from the exercise of our external senses; but it is equally certain, that when the notions of magnitude and figure have once been acquired, the mind is immediately led to consider them as attributes of space no less than of body; and (abstracting them entirely from the other sensible qualities perceived in conjunction with them,) becomes impressed with an irresistible conviction, that their existence is necessary and eternal, and that it would remain unchanged if all the bodies in the universe were annihilated. It is not our business here to inquire into the origin and grounds of this conviction. It is with the *fact* alone that we are concerned at present; and this I conceive to be one of the most obviously incontrovertible which the circle of our knowledge embraces. Let those explain it as they best can, who are of opinion, that all the judgments of the human understanding rest ultimately on observation and experience.

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* Philosophical Essays, pp. 94, 95.

Nor is this the only case in which the mind forms conclusions concerning space, to which those of the natural philosopher do not bear the remotest analogy. Is it from experience we learn that space is infinite? or (to express myself in more unexceptionable terms,) that no limits can be assigned to its immensity! Here is a fact, extending not only beyond the reach of our personal observation, but beyond the observation of all created beings; and a fact on which we pronounce with no less confidence, when in imagination we transport ourselves to the utmost verge of the material universe, than when we confine our thoughts to those regions of the globe which have been explored by travellers. How unlike those general laws which we investigate in physics, and which, how far soever we may find them to reach, may still, for any thing we are able to discover to the contrary, be only contingent, local, and temporary!

It must indeed be owned, with respect to the conclusions hitherto mentioned on the subject of space, that they are rather of a metaphysical than of a mathematical nature; but they are not, on that account, the less applicable to our purpose; for if the theory of Beddoes had any foundation, it would lead us to identify with physics the former of these sciences as well as the latter; at least, all that part of the former which is employed about space, or extension,—a favourite object of metaphysical as well as of mathematical speculation. The truth, however, is, that some of our metaphysical conclusions concerning space are more nearly allied to geometrical theorems than we might be disposed at first to apprehend; being involved or implied in the most simple and fundamental propositions which occur in Euclid's Elements. When it is asserted, for example, that "if one straight line falls on two other straight lines, so as to make the two interior angles on the same side together equal to two right angles, these two straight lines, though indefinitely produced, will never meet;"—is not the boundless immensity of space tacitly assumed as a thing unquestionable? And is not a universal affirmation made with respect to a fact which experience is equally incompetent to disprove or to confirm? In like manner, when it is said, that "triangles on the same base, and between the same parallels are equal," do we feel ourselves the less ready to give our assent to the demonstration, if it should be supposed, that the one triangle is confined within the limits of the paper before us, and that the other, standing on the same base, has its vertex placed beyond the sphere of the fixed stars? In various instances, we are led, with a force equally imperious, to acquiesce in conclusions, which not only admit of no illustration or proof from the perceptions of sense, but which, at first sight, are apt to stagger and confound the faculty of imagination. It is sufficient to mention, as examples of this, the relation between the hyperbola and its asymptotes; and the still more obvious truth of the infinite divisibility of extension. What analogy is there between such propositions as these, and that which announces, that the mercury in the Torricellian tube will fall, if carried up to the top of a mountain; or that the vibrations of a pendulum of a given length will be performed in the same time, while it remains in the same latitude? Were there, in reality, that analogy between mathematical and physical propositions, which Beddoes and his followers have fancied, the equality of the square of the hypothenuse of a right angled triangle to the squares described on the two other sides, and the proportion of 1, 2, 3, between the cone and its circumscribed hemisphere and cylinder, might, with fully as great propriety, be considered in the light of physical phenomena, as of geometrical theorems: Nor would it have been at all inconsistent with the logical unity of his work, if Mr. Leslie had annexed to his Elements of Geometry, a scholium concerning the final causes of circles and of straight lines, similar to that which, with such sublime effect, closes the Principia of Sir Isaac Newton.*

* In the course of my own experience, I have met with *one* person, of no common ingenuity, who seemed seriously disposed to consider the truths of geometry very nearly in this light. The person I allude to was James Ferguson, author of the justly popular works on Astronomy and Mechanics. In the year 1768, he paid a visit to Edinburgh, when I had not only an opportunity of attending his public course of lectures, but of frequently enjoying, in private, the pleasure of his very interesting conversation. I remember distinctly to have heard him say, that he had more than once attempted to study the Elements of Euclid; but found himself quite unable to enter into that species of reasoning. The second proposition of the first book, he mentioned particularly as one of his stumbling-blocks at the very outset;—the circuitous process by which Euclid sets about an operation which never could puzzle, for a single moment, any man who had seen a pair of compasses, appearing to him altogether capricious and ludicrous. He added, at the same time, that as there were various geometrical theorems of which he had daily occasion to make use, he had satisfied himself of their truth, either by means of his compasses and scale, or by some mechanical contrivances of his own invention. Of one of these I have still a perfect recollection;—his mechanical or experimental demonstration of the 47th proposition of Euclid's first Book, by cutting a card so as to afford an ocular proof, that the squares of the two sides actually filled the same space with the square of the hypothenuse.

2. It yet remains for me to say a few words upon that superposition of triangles which is the ground-work of all our geometrical reasonings concerning the relations which different spaces bear to one another in respect of magnitude. And here I must take the liberty to remark, in the first place, that the fact in question has been stated in terms much too loose and incorrect for a logical argument. When it is said, that "all the fundamental theorems which relate to the comparison of triangles, derive their evidence from the *mere* superposition of the triangles themselves," it seems difficult, or rather impossible, to annex to the adjective *mere*, an idea at all different from what would be conveyed, if the word *actual* were to be substituted in its place; more especially, when we attend to the assertion which immediately follows, that "this mode of proof is, in

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To those who reflect on the disadvantages under which Mr. Ferguson had laboured in point of education, and on the early and exclusive hold which experimental science had taken of his mind, it will not perhaps seem altogether unaccountable, that the refined and scrupulous logic of Euclid should have struck him as tedious, and even unsatisfactory, in comparison of that more summary and palpable evidence on which his judgment was accustomed to rest. Considering, however, the great number of years which have elapsed since this conversation took place, I should have hesitated about recording, solely on my own testimony, a fact so singular with respect to so distinguished a man, if I had not lately found, from Dr. Hutton's Mathematical Dictionary, that *he* also had heard from Mr. Ferguson's mouth, the most important of those particulars which I have now stated; and of which my own recollection is probably the more lively and circumstantial, in consequence of the very early period of my life when they fell under my notice.

"Mr Ferguson's general mathematical knowledge (says Dr. Hutton) was little or nothing. Of algebra, he understood little more than the notation; and he has often told me he could never demonstrate one proposition in Euclid's Elements; his constant method being to satisfy himself, as to the truth of any problem, with a measurement by scale and compasses." (*Hutton's Mathematical and Philosophical Dictionary, Article, Ferguson.*)

reality, nothing but an ultimate appeal, though of the easiest and most familiar kind, to *external observation*." But if this be, in truth, the sense in which we are to interpret the statement quoted above, (and I cannot conceive any other interpretation of which it admits,) it must appear obvious, upon the slightest reflection, that the statement proceeds upon a total misapprehension of the principle of *superposition;* inasmuch as it is not to an actual or *mere* superposition, but to an imaginary or ideal one, that any appeal is ever made by the geometer. Between these two modes of proof, the difference is not only wide, but radical and essential. The one would, indeed, level geometry with physics, in point of evidence, by building the whole of its reasonings on *a fact* ascertained by mechanical measurement: The other is addressed to the understanding, and to the understanding alone, and is as rigorously conclusive as it is possible for demonstration to be.*

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* The same remark was, more than fifty years ago, made by D'Alembert, in reply to some mathematicians on the Continent, who, it would appear, had then adopted a paradox very nearly approaching to that which I am now combating. "Le principie de la superposition n'est point, comme l'ont prétendu plusieurs géometres, une méthode de démontrer peu exacte et purement méchanique. La superposition, telle que les mathématiciens la conçoivent, ne consiste pas à appliquer grossièrement une figure sur une autre, pour juger par les yeux de leur égalité ou de leur difference, comme un oubrier applique son pié sur une ligne pour la mesurer ; elle consiste à imaginer une figure transportée sur une autre, et à conclure de l'égalité supposèe de certaines parties de deux figures, la coincidence de ces parties entr'elles, et de leur coincidence la coincidence du reste : d'où résulte l'egalité et la similitude parfaites des figures entières."

About a century before the time when D'Alembert wrote these observations, a similar view of the subject was taken by Dr. Barrow, a writer who, like D'Alembert, added to the skill and originality of an inventive mathematician, the most refined, and, at the same time, the justest ideas concerning the theory of those intellectual processes which are subservient to mathe-

That the reasoning employed by Euclid in proof of the fourth proposition of his first book is completely *demonstrative*, will be readily granted by those who compare its different steps with the conclusions to which we were formerly led, when treating of the nature of mathematical demonstration. In none of these steps is any appeal made to *facts* resting on the evidence of sense, nor indeed to any *facts* whatever. The constant appeal is to the *definition* of equality."* "Let the triangle A B C (says Euclid) be applied to the triangle D E F; the point A to the point D, and the straight line A B to the straight line D E; the point B *will* coincide with the point E, be-

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matical reasoning.—"Unde meritò vir acutissimus Willebrordus Snellius luculentissimum appellat geometriæ supellectilis instrumentum hanc ipsam εφαρμοσιν. *Eam igitur in demonstrationibus mathematicis qui fastidiunt et respuunt, ut mechanicæ crassitudinis ac αυτουργιας aliquid redolentem, ipsissimam geometriæ basin labefactare student; ast imprudenter et frustra.* Nam εφαρμοσιν geometræ suam non manu sed mente peragunt, non oculi sensu, sed animi judicio æstimant. Supponunt (id quod nulla manus præstare, nullus sensus discernere valet) accuratam et perfectam congruentiam, ex eàque supposità justas et logicas eliciunt consequentias. Nullus hic regulæ, circini, vel normæ usus, nullus brachiorum labor, aut laterum contentio, rationis totum opus, artificium et machinatio est; nil mechanicam sapiens αυτουργιαν exigitur; nil, inquam, mechanicum, nisi quatenus omnis magnitudo sit aliquo modo materiæ involuta, sensibus exposita, visibilis et palpabilis, sic ut quod mens intelligi jubet, id manus qua dantenus exequi possit, et contemplationem praxis utcunque conetur æmulari. Quæ tamen imitatio geometricæ demonstrationis robur ac dignitatem nedum non infirmat aut deprimit, at validius constabilit, et atollit altius," &c. *Lectiones Mathematicæ*, Lect. III.

* It was before observed (seep. 160) that Euclid's eighth (*axiom, magnitudes which coincide with each other are equal*) ought, in point of logical rigour, to have been stated in the form of a *definition*. In our present argument, however, it is not of material consequence whether this criticism be adopted or not. Whether we consider the proposition in question in the light of an axiom or of a definition, it is equally evident that it does not express a *fact* ascertained by observation or by experiment.

cause *A B is equal to D E.* And A B coinciding with D F, A C *will* coincide with D F, *because the angle B A C is equal to the angle E D F.*" A similar remark will be found to apply to every remaining step of the reasoning; and, therefore, this reasoning possesses the peculiar characteristic which distinguishes mathematical evidence from that of all the other sciences,—that it rests wholly on *hypotheses* and *definitions*, and in no respect upon any statement of *facts*, true or false. The ideas, indeed, of extension of a triangle, and of equality, presuppose the exercise of our senses. Nay, the very idea of *superposition* involves that of *motion*, and consequently (as the parts of space are immoveable) of a *material triangle.* But where is there any thing analogous in all this, to those *sensible facts*, which are the principles of our reasoning in physics; and which, according as they have been accurately or inaccurately ascertained, determine the accuracy or inaccuracy of our conclusions? The *material* triangle itself, as conceived by the mathematician, is the object, not of sense, but of intellect. It is not an actual *measure*, liable to expansion or contraction, from the influence of heat or of cold; nor does it require, in the ideal use which is made of it by the student, the slightest address of hand or nicety of eye. Even in explaining the demonstration, for the first time, to a pupil, how slender soever his capacity might be, I do not believe that any teacher ever thought of illustrating its meaning by the actual application of the one triangle to the other. No teacher, at least, would do so, who had formed correct notions of the nature of mathematical science.

If the justness of these remarks be admitted, the *demonsrtation* in question must be allowed to be as well entitled to the name, as any other which the mathematician can produce; for as our conclusions relative to the properties of the circle (considered in the light of hypothetical theorems) are not the less rigorously and necessarily true, that no material circle may any where exist corresponding exactly to the definition of that figure, so the proof given by Euclid of the fourth proposition, would not be the less demonstrative, although our senses were incomparably less acute than they are, and although no material triangle continued of the same magnitude for a single instant. Indeed, when we have once acquired the ideas of equality and of a common measure, our mathematical conclusions would not be in the least affected, if all the bodies in the universe should vanquish into nothing.

To many of my readers, I am perfectly aware, the foregoing remarks will be apt to appear tedious and superfluous. My only apology for the length to which they have extended is, my respect for the talents and learning of some of those writers who have lent the sanction of their authority to the logical errors which I have been endeavouring to correct; and the obvious inconsistency of these conclusions with the doctrine concerning the characteristics of mathematical or demonstrative evidence, which it was the chief object of this section to establish.*

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* This doctrine is concisely and clearly stated by a writer, whose acute and original, though very eccentric genius, seldom fails to redeem his wildest paradoxes by the new lights which he strikes out in defending them." "Demonstratio est syllogismus vel syllogismorum series à nominum definitionibus usque ad conclusionem ultimam derivata." *Computatio sive Logica*, cap. 6.

It will not, I trust, be inferred, from my having adopted, in the words of Hobbes, this detached proposition, that I am disposed to sanction any one of those conclusions which have been commonly *supposed* to be connected with

SECTION IV.

Of our Reasonings concerning Probable or Contingent Truths.

I.

Narrow Field of demonstrative Evidence.—Of demonstrative Evidence, when combined with that of SENSE, *as in Practical Geometry; and with those of Sense and of* INDUCTION, *as in the Mechanical Philosophy.—Remarks on a Fundamental Law of Belief, involved in all our Reasonings concerning Contingent Truths.*

IF the account which has been given of the nature of demonstrative evidence be admitted, the province over which it extends must be limited almost entirely to the objects of pure mathematics. A science perfectly analo-

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it, in the mind of the author:—I say, *supposed*, because I am by no means satisfied, (notwithstanding the loose and unguarded manner in which he has stated some of his logical opinions) that justice has been done to his views and motives in *this* part of his works. My own notions on the subject of evidence in general, will be sufficiently unfolded in the progress of my speculations. In the meantime, to prevent the possibility of any misapprehension of my meaning, I think it proper once more to remark, that the definition of Hobbes, quoted above, is to be understood (according to *my* interpretation of it) as applying solely to the word *demonstration* in pure mathematics. The extension of the same term by Dr. Clarke and others, to reasonings which they have for their object, not conditional or hypothetical, but absolute truth, appears to me to have been attended with many serious inconveniencies, which these excellent authors did not foresee. Of the *demonstrations* with which Aristotle has attempted to fortify his [illegible] shall afterwards have occasion to examine the [illegible] gous to this, in point of evidence, may indeed be conceived (as I have already remarked) to consist of a series of propositions relating to moral, to political, or to physical subjects, but as it could answer no other purpose than to display the ingenuity of the inventor, hardly any thing of the kind has been hitherto attempted. The only exception which I can think of, occurs in the speculations formerly mentioned under the title of *theoretical mechanics*.

But if the field of mathematical demonstration be limited entirely to hypothetical or conditional truths, whence (it may be asked) arises the extensive and the various utility of mathematical knowledge, in our physical researches, and in the arts of life? The answer, I apprehend, is to be found in certain peculiarities of those objects to which the suppositions of the mathematician are confined; in consequence of which peculiarities, real combinations of circumstances may fall under the examination of our senses, approximating far more nearly to what his definitions describe, than is to be expected in

The charge of *unlimited* scepticism brought against Hobbes, has, in my opinion, been occasioned, partly by his neglecting to draw the line between absolute and hypothetical truth, and partly by his applying the word *demonstration* to our reasonings in other sciences as well as in mathematics. To these causes may perhaps be added, the offence which his logical writings must have given to the Realists of his time.

It is not, however, to Realists alone, that the charge has been confined. Leibnitz himself has given some countenance to it, in a dissertation prefixed to a work of Marius Nizolius; and Brucker, in referring to this dissertation, has aggravated not a little the censure of Hobbes, which it seems to contain. "Quin si illustrem Leibnitzium audimus, Hobbesius quoque inter nominales referendus est, eam ob causam, quod *ipso Occamo nominalior*, rerum veritatem dicat in nominibus consistere, ac, quod, majus est, pendere ab arbitrio humano." *Histor. Philosoph. de Ideis*, p. 209. Augustæ Vindelicorum, 1723.

any other theoretical process of the human mind. Hence a corresponding coincidence between his abstract conclusions, and those facts in practical geometry and in physics which they help him to ascertain.

For the more complete illustration of this subject, it may be observed, in the first place, that although the peculiar force of that reasoning which is properly called *mathematical*, depends on the circumstance of its principles being *hypothetical*, yet if, in any instance, the supposition could be ascertained as actually existing, the conclusion might, with the very same certainty, be applied. If I were satisfied, for example, that in a particular circle drawn on paper, all the *radii* were exactly equal, every property which Euclid has demonstrated of that curve might be confidently affirmed to belong to this diagram. As the thing, however, here supposed, is rendered impossible by the imperfection of our senses, the truths of geometry can never, in their practical applications, possess *demonstrative* evidence; but only that kind of evidence which our organs of perception enable us to obtain.

But although, in the practical applications of mathematics, the *evidence* of our conclusions differs essentially from that which belongs to the truths investigated in the theory, it does not therefore follow, that these conclusions are the less important. In proportion to the accuracy of our *data* will be that of all our subsequent deductions; and it fortunately happens, that the same imperfections of sense which limit what is physically attainable in the former, limit also, to the very same extent, what is practically useful in the latter. The astonishing precision which the mechanical ingenuity of modern times has given to mathematical instruments, has, in fact, communicated a nicety to the results of practical geometry, beyond the ordinary demands of human life, and far beyond the most sanguine anticipations of our forefathers.[*]

This remarkable, and indeed singular coincidence of propositions purely hypothetical, with facts which fall under the examination of our senses, is owing, as I already hinted, to the peculiar nature of the *objects* about which mathematics is conversant; and to the opportunity which we have (in consequence of that *mensurability*[†] which belongs to all of them) of adjusting, with a degree of accuracy approximating nearly to the truth, the *data* from which we are to reason in our practical operations, to those which are assumed in our theory. The only affections of matter which these objects comprehend are extension and figure; affections which matter possesses in common with space, and which may therefore be separated in fact, as well as abstracted in thought, from all its other sensible qualities. In examining, accordingly, the relations of *quantity* connected with these affections, we are not liable to be disturbed by those physical *accidents*, which, in the other applications of mathematical science, necessarily render the result, more or less, at variance with the theory. In measuring the height of a mountain, or in the survey of a country, if we are at due pains in ascertaining our data, and if we reason from them with mathematical strictness, the result may be depended on as accurate within very narrow limits; and as there is nothing but the incorrectness of our data by which the result can be vitiated, the limits of possible error may themselves be assigned. But, in the simplest applications of mathematics to mechanics or to physics, the abstractions which are necessary in the theory, must always leave out circumstances which are essentially connected with the effect. In demonstrating, for example, the property of the lever, we abstract entirely from its own weight, and consider it as an inflexible mathematical line;—suppositions with which the fact cannot possibly correspond; and for which, of course, allowances (which nothing but physical experience can enable us to judge of,) must be made in practice.*

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[*] See a very interesting and able article, in the fifth volume of the Edinburgh Review, on Colonel Mudge's account of the operations carried on for accomplishing a trigonometrical survey of England and Wales. I cannot deny myself the pleasure of quoting a few sentences.

"In two distances that were deduced from sets of triangles, the one measured by General Roy in 1787, the other by Major Mudge in 1794, one of 24.133 miles, and the other of 38.688, the two measures agree within a foot as to the first distance, and 16 inches as to the second. Such an agreement, where the observers and the instruments were both different, where the lines measured were of such extent, and deduced from such a variety of *data*, is probably without any other example. Coincidences of this sort are frequent in the trigonometrical survey, and prove how much more good instruments, used by skilful and attentive observers, are capable of performing, than the most sanguine theorist could have ever ventured to foretell.—

"It is curious to compare the early essays of practical geometry with the perfection to which its operations have now reached, and to consider that, while the artist had made so little progress, the theorist had reached many of the sublimest heights of mathematical speculation; that the latter had found out the area of the circle, and calculated its circumference to more than a hundred places of decimals, when the former could hardly divide an arch into minutes of a degree; and that many excellent treatises had been written on the properties of curve lines, before a straight line of considerable length had ever been carefully drawn, or exactly measured on the surface of the earth."

[†] See note (G.)

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* See note (H.)

Next to *practical geometry*, properly so called, one of the easiest applications of mathematical theory occurs in those branches of optics which are distinguished by the name of catoptrics and dioptrics. In these, the physical principles from which we reason are few and precisely definite, and the rest of the process is as purely geometrical as the Elements of Euclid.

In that part of astronomy, too, which relates solely to the phenomena, without any consideration of physical causes, our reasonings are purely geometrical. The *data* indeed on which we proceed must have been previously ascertained by observation; but the inferences we draw from these are connected with them by mathematical demonstration, and are accessible to all who are acquainted with the theory of spherics.

In *physical* astronomy, the law of gravitation becomes also a principle or *datum* in our reasonings; but as in the celestial phenomena, it is disengaged from the effects of the various other causes which are combined with it near the surface of our planet, this branch of physics, as it is of all the most sublime and comprehensive in its objects, so it seems, in a greater degree than any other, to open a fair and advantageous field for mathematical ingenuity.

In the instances which have been last mentioned, the evidence of our conclusions resolves ultimately not only into that of sense, but into another law of belief formerly mentioned; that which leads us to expect the continuance, in future, of the established order of physical phenomena. A very striking illustration of this presents itself in the computations of the astronomer; on the faith of which he predicts, with the most perfect assurance, many centuries before they happen, the appearances which the heavenly bodies are to exhibit. The same fact is assumed in all our conclusions in natural philosophy; and something extremely analogous to it in all our conclusions concerning human affairs. They relate, in both cases, not to necessary connexions, but to *probable* or *contingent* events; of which (how confidently soever we may expect them to take place,) the failure is by no means perceived to be impossible. Such conclusions, therefore, differ essentially from those to which we are led by the demonstrations of pure mathematics, which not only command our assent to the theorems they establish, but satisfy us that the contrary suppositions are absurd.

These examples may suffice to convey a general idea of the distinction between demonstrative and probable evidence; and I purposely borrowed them from sciences where the two are brought into immediate contrast with each other, and where the authority of both has hitherto been equally undisputed.

Before prosecuting any farther the subject of probable evidence, some attention seems to be due, in the first place, to the grounds of that fundamental supposition on which it proceeds,—*the stability of the order of nature.* Of this important subject, accordingly, I propose to treat at some length.

II.

Continuation of the Subject.—Of that Permanence or Stability in the Order of Nature, which is presupposed in our Reasonings concerning Contingent Truths.

I HAVE already taken notice of a remarkable principle of the mind, (whether coeval with the first exercise of its powers, or the gradual result of habit, it is not at present material to inquire,) in consequence of which, we are irresistibly led to apply to future events the results of our past experience. In again resuming the subject, I do not mean to add any thing to what was then stated concerning the origin or the nature of this principle; but shall confine myself to a few reflections on that established order in the succession of events, which it unconsciously assumes as a fact; and which, if it were not real, would render human life a continued series of errors and disappointments. In any incidental remarks that may occur on the principle itself, I shall consider its existence as a thing universally acknowledged, and shall direct my attention chiefly to its practical effects;—effects which will be found to extend equally to the theories of the learned, and to the prejudices of the vulgar. The question with regard to its *origin* is, in truth, a problem of mere curiosity; for of its actual influence on our belief, and on our conduct, no doubts have been suggested by the most sceptical writers.

Before entering, however, upon the following argument, it may not be superfluous to observe, with respect to this expectation, that, in whatever manner it at first arises, it cannot fail to be mightily confirmed and strengthened by habits of scientific research; the tendency of which is to familiarize us more and more with the simplicity and the uniformity of physical laws, by gradually reconciling with them, as our knowledge extends, those phenomena which we had previously been disposed to consider in the light of exceptions. It is thus that, when due allowances are made for the different circumstances of the two events, the ascent of smoke appears to be no less a proof of the law of gravitation than the fall of a stone. This simplification and generalization of the laws of nature is one of the greatest pleasures which philosophy yields; and the growing confidence with which it is anticipated, forms one of the chief incentives to philosophical pursuits. Few experiments, perhaps, in physics, afford more exquisite delight to the novice, or throw a stronger light on the nature and object of that science, than when he sees, for the first time, the guinea and the feather drop together in the exhausted receiver.

In the language of modern science, the established order in the succession of physical events is commonly referred (by a sort of figure or metaphor) to *the general laws of nature*. It is a mode of speaking extremely convenient from its conciseness, but is apt to suggest to the fancy a groundless, and indeed absurd analogy between the material and the moral worlds. As the order of society results from the *laws* prescribed by the legislator, so the order of the universe is conceived to result from certain *laws* established by the Deity. Thus, it is customary to say, that the fall of heavy bodies towards the earth's surface, the ebbing and flowing of the sea, and the motions of the planets in their orbits, are consequences of the *law* of gravitation. But although, in one sense, this may be abundantly accurate, it ought always to be kept in view, that it is not a literal but a metaphorical statement of the truth; a statement somewhat analogous to that poetical expression in the sacred writings, in which God is said "to have given his decree to the seas, that they should not pass his commandment." In those political associations from which the metaphor is borrowed, the laws are addressed to rational and voluntary agents, who are able to comprehend their meaning, and to regulate their conduct accordingly; whereas, in the material universe, the subjects of our observation are understood by all men to be unconscious and passive, (that is, are understood to be unchangeable in their state, without the influence of some foreign and external force) and consequently *the order* so admirably maintained, amidst all the various *changes* which they actually undergo, not only implies *intelligence* in its first conception, but implies, in its continued existence, the incessant agency of *power*, executing the purposes of wise design. If the word *law*, therefore, be, in such instances, literally interpreted, it must mean a uniform mode of operation, prescribed by the Deity to himself; and it has accordingly been explained in this sense by some of our best philosophical writers, particularly by Dr. Clarke.* In employing, however, the word with an exclusive reference to experimental philosophy, it is more correctly logical to consider it as merely a statement of some *general fact* with respect to the order of nature;—a fact which has been found to hold uniformly in our past experience, and on the continuance of which, in future, the constitution of our mind determines us confidently to rely.

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* So likewise Halley, in his Latin verses prefixed to Newton's *Principia:*

> " En tibi norma poli, et divæ libramina molis,
> Computus en Jovis; et *quas, dum primordia rerum*
> *Pangeret, omniparens leges violare Creator*
> *Noluit.*"

After what has been already said, it is hardly necessary to take notice of the absurdity of that opinion, or rather of that mode of speaking, which seems to refer the order of the universe to *general laws* operating as *efficient causes*. Absurd, however, as it is, there is reason to suspect, that it has, with many, had the effect of keeping the Deity out of view, while they were studying his works. To an incautious use of the same very equivocal phrase, may be traced the bewildering obscurity in the speculations of some eminent French writers, concerning its metaphysical import. Even the great Montesquieu, in the very first chapter of his principal work, has lost himself in a fruitless attempt to explain its meaning, when, by a simple statement of the essential distinction between its literal and its metaphorical acceptations, he might have at once cleared up the mystery. After telling us that "laws, in their most extensive signification, are the necessary relations (*les rapports nécessaires*) which arise from the nature of things, and that, in this sense, *all* beings have their laws;—that the Deity has *his* laws; the material world *its* laws; intelligences superior to man *their* laws; the brutes *their* laws; man *his* laws;"—he proceeds to remark, "That the moral world is far from being so well governed as the material; for the former, although it has *its* laws, which are invariable, does not observe these laws so constantly as the latter." It is evident that this remark derives whatever plausibility it possesses from a play upon words; from confounding *moral* laws with *physical*; or, in plainer terms, from confounding laws which are addressed by a legislator to intelligent beings, with those general conclusions concerning the established order of the universe, to which, when legitimately inferred from an induction sufficiently extensive, philosophers have metaphorically applied the title of *Laws of Nature.* In the one case, the conformity of the law with the nature of things, does not at all depend on its being observed or not, but on the reasonableness and moral obligation of the law. In the other case, the very definition of the word *law* supposes that it applies universally; insomuch that, if it failed in one single instance, it would cease to be a *law*. It is, therefore, a mere quibble to say, that the laws of the material world are better observed than those of the moral; the meaning of the word *law*, in the two cases to which it is here applied, being so totally different, as to render the comparison or contrast, in the statement of which it is involved, altogether illusory and sophistical. Indeed, nothing more is necessary to strip the proposition of every semblance of plausibility, but an attention to this verbal ambiguity.*

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* I do not recollect any instance in the writings of Montesquieu, where he has reasoned more vaguely than in this chapter; and yet I am inclined to believe, that few chapters in the *Spirit of Laws* have been more admired. " Montesquieu (says a French writer) paroissoit à Thomas le premier des écrivains, pour la force et l'étendue des idées, pour la multitude, la profondeur, la nouveauté des rapports. Il est incroyable (disoit-il) tout ce que Montesquieu a fait apperçeuoir dans ce mot si court, le mot Loi." (*Nouveau Diction. Historique*, Art. *Thomas*. Lyon, 1814.

For some important remarks on the distinction between moral and physical laws, see Dr. Ferguson's Institutes of Moral Philosophy, last edit.

This metaphorical employment of the word *law*, to express a general fact, although it does not appear to have been adopted in the technical phraseology of ancient philosophy, is not unusual among the classical writers, when speaking of those physical arrangements, whether on the earth or in the heavens, which continue to exhibit the same appearance from age to age.

> "Hic segetes, illic veniunt felicius uvæ:
> Arborei fetus alibi, atque injussa virescunt
> Gramina. Nonne vides, croceos ut Timolus odores,
> India mittit ebur, molles sua thura Sabæi?
> At Chalybes nudi ferrum, virosaque Pontus
> Castorea, Eliadum palmas Epiros equarum?
> Continuo has *leges*, æternaque fœdera certis
> Imposuit natura locis."[*]

The same metaphor occurs in another passage of the Georgics, where the poet describes the regularity which is exhibited in the economy of the bees:

> "Solæ communes natos, consortia tecta
> Urbis habent, magnisque agitant *sub legibus* ævum."[†]

The following lines from Ovid's account of the Pythagorean philosophy, are still more in point:

> "Et rerum causas, et quid natura docebat;
> Quid Deus: Unde nives: quæ fulminis esset origo:
> Jupiter, an venti, discussa nube tonarent:
> Quid quateret terras, quâ sidera *lege* mearent,
> Et quodcunque latet."[‡]

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[*] Virg. I. Georg. 60. [†] Georg. IV. 153. [‡] Ovid. Met. XV. 68.

I shall only add to these quotations the epigram of Claudian on the instrument said to be invented by Archimedes for representing the move-

I have quoted these different passages from ancient authors, chiefly as an illustration of the strength and of the similarity of the impression which the order of nature has made on the minds of reflecting men, in all ages of the world. Nor is this wonderful; for were things differently constituted, it would be impossible for man to derive benefit from experience; and the powers of observation and memory would be subservient only to the gratification of an idle curiosity. In consequence of those uniform laws by which the succession of events is actually regulated, every fact collected with respect to the past is

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ments of the heavenly bodies, in which various expressions occur coinciding remarkably with the scope of the foregoing observations.

> "Jupiter in parvo cum cerneret æthera vitro
> Risit, et ad superos talia dicta dedit.
> Huccine mortalis progressa potentia curæ;
> Jam meus in fragili luditur orbe labor.
> *Jura Poli, rerumque fidem, legesque Deorum*
> Ecce Syracusius transtulit arte senex.
> Inclusus variis famulatur spiritus astris,
> Et vivum certis motibus urget opus.
> Percurrit proprium mentitus signifer annum,
> Et simulata novo Cynthia mynse redit.
> Jamque suum volvens audax industria mundum
> Gaudet, et humana Sydera mente regit.
> Quid falso insontem tonitru Salmonea miror?
> Æmula naturæ parva reperta manus."

In the progress of philosophical refinement at Rome, this metaphorical applica[illegible]n of the word *law* seems to have been attended with the same consequences which (as I already observed) have resulted from an incautious use of it among some philosophers of modern Europe. Pliny tells us, that, in his time, these consequences extended both to the lettered, and to to the unlettered multitude. "Pars alia astro suo eventus assignat, et *nascendi legibus;* semelque in omnes futuros unquam Deo decretum, in reliquum vero otium datum. Sedere cæpit sententia hæc, pariterque *et eruditum vulgus et rude* in eam cursu vadit." (*Plin. Nat. Hist.* Lib. ii.)

a foundation of sagacity and of skill with respect to the future; and, in truth, it is chiefly this application of experience to anticipate what is yet to happen, which forms the intellectual superiority of one individual above another. The remark holds equally in all the various pursuits of mankind, whether speculative or active. As an astronomer is able, by reasonings founded on past observations, to predict those phenomena of the heavens which astonish or terrify the savage;—as the chemist, from his previous familiarity with the changes operated upon bodies by heat or by mixture, can predict the result of innumerable experiments, which to others furnish only matter of amusement and wonder;—so a studious observer of human affairs acquires a prophetic foresight (still more incomprehensible to the multitude) with respect to the future fortunes of mankind;—a foresight which, if it does not reach, like our anticipations in physical science, to particular and definite events, amply compensates for what it wants in precision, by the extent and variety of the prospects which it opens. It is from this apprehended analogy between the future and the past, that historical knowledge derives the whole of its value; and were the analogy completely to fail, the records of former ages would, in point of utility, rank with the fictions of poetry. Nor is the case different in the business of common life. Upon what does the success of men in their private concerns so essentially depend as on their own *prudence*; and what else does this word mean, than a wise regard, in every step of their conduct, to the lessons which experience has taught them?*

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* "Prudentiam quodammodo esse divinationem." *Corn. Nep. in vita Attici.*

The departments of the universe in which we have an opportunity of seeing this *regular order* displayed, are the three following: 1. The phenomena of inanimate matter; 2. The phenomena of the lower animals; and, 3. The phenomena exhibited by the human race.

1. On the first of these heads, I have only to repeat what was before remarked, That, in all the phenomena of the material world, the uniformity in the order of events is conceived by us to be complete and infallible; insomuch that, to be assured of the same result upon a repetition of the same experiment, we require only to be satisfied, that both have been made in circumstances precisely similar. A single experiment, accordingly, if conducted with due attention, is considered, by the most cautious inquirers, as sufficient to establish a general physical fact; and if, on any occasion, it should be repeated a second time, for the sake of greater certainty in the conclusion, it is merely with a view of guarding against the effects of the accidental concomitants which may have escaped notice, when the first result was obtained.

2. The case is nearly similar in the phenomena exhibited by the brutes; the various tribes of which furnish a subject of examination so steady, that the remarks made on a few individuals may be extended, with little risk of error, to the whole species. To this uniformity in their instincts it is owing, that man can so easily maintain his empire over them, and employ them as agents or instruments for accomplishing his purposes; advantages which would be wholly lost to him, if the operations of instinct were as much diversified as those of human reason.

Here therefore we may plainly trace a purpose or design, perfectly analogous to that already remarked, with respect to the laws which regulate the material world; and the difference, in point of exact uniformity, which distinguishes the two classes of events, obviously arises from a certain latitude of action, which enables the brutes to accommodate themselves, in some measure, to their accidental situations;—rendering them, in consequence of this power of accommodation, incomparably more serviceable to our race than they would have been, if altogether subjected, like mere matter, to the influence of regular and assignable causes. It is, moreover, extremely worthy of observation, concerning these two departments of the universe, that the uniformity in the phenomena of the latter presupposes a corresponding regularity in the phenomena of the former; insomuch that, if the established order of the material world were to be essentially disturbed, (the instincts of the brutes remaining the same) all their various tribes would inevitably perish. The uniformity of animal instinct, therefore, bears a reference to the constancy and immutability of physical laws, not less manifest, than that of the fin of the fish to the properties of the water, or of the wing of the bird to those of the atmosphere.

3. When from the phenomena of inanimate matter and those of the lower animals, we turn our attention to the history of our own species, innumerable lessons present themselves for the instruction of all who reflect seriously on the great concerns of human life. These lessons require, indeed, an uncommon degree of acuteness and good sense to collect them, and a still more uncommon degree

of caution to apply them to practice; not only because it is difficult to find cases in which the combinations of circumstances are exactly the same; but because the peculiarities of individual character are infinite, and the real springs of action in our fellow-creatures are objects only of vague and doubtful conjecture. It is, however, a curious fact, and one which opens a wide field of interesting speculation, that, in proportion as we extend our views from particulars to generals, and from individuals to communities, human affairs exhibit, more and more, a steady subject of philosophical examination, and furnish a greater number of general conclusions to guide our conjectures concerning future contingencies. To speculate concerning the character or talents of the individual who shall possess the throne of a particular kingdom, a hundred years hence, would be absurd in the extreme: But to indulge imagination in anticipating, at the same distance of time, the condition and character of any great nation, with whose manners and political situation we are well acquainted, (although even here our conclusions may be widely erroneous) could not be justly censured as a misapplication of our faculties equally vain and irrational with the former. On this subject, Mr. Hume has made some very ingenious and important remarks in the beginning of his Essay on the Rise and Progress of the Arts and Sciences.

The same observation is applicable to all other cases, in which events depend on a multiplicity of circumstances. How accidental soever these circumstances may appear; and how much soever they may be placed, when individually considered, beyond the reach of our calculations, experience shows, that they are somehow or other mutually adjusted, so as to produce a certain degree of uniformity in the result; and this uniformity is the more complete, the greater is the number of circumstances combined. What can appear more uncertain than the proportion between the sexes among the children of any one family! and yet how wonderfully is the balance preserved in the case of a numerous society! What more precarious than the duration of life in an individual! and yet, in a long list of persons of the same age, and placed in the same circumstances, the mean duration of life is found to vary within very narrow limits. In an extensive district, too, a considerable degree of regularity may sometimes be traced for a course of years, in the proportion of births and of deaths, to the number of the whole inhabitants. Thus, in France, Necker informs us, that "the number of births is in proportion to that of the inhabitants as one to twenty-three and twenty-four, in the districts that are not favoured by nature, nor by moral circumstances: this proportion is as one to twenty-five, and twenty-five and a half, and twenty-six in the greatest part of France: in cities, as one to twenty-seven, twenty-eight, twenty-nine, and even thirty, according to their extent and their trade." "Such proportions, (he observes) can only be remarked in districts where there are no settlers nor emigrants; but even the differences arising from these (the same author adds,) and many other causes, acquire a kind of uniformity, when collectively considered, and in the immense extent of so great a kingdom."*

It may be worth while to remark, that it is on these principles that all the different institutions for Assurances are founded. The object at which they all aim, in common, is, to diminish the number of *accidents* to which human life is exposed; or rather, to counteract the inconveniencies resulting from the irregularity of individual events, by the uniformity of general laws.

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* Traité de l'Administration des Finances de France.

The advantages which we derive from such general conclusions as we possess concerning the order of nature, are so great, and our propensity to believe in its existence is so strong, that, even in cases where the succession of events appears the most anomalous, we are apt to suspect the operation of fixed and constant laws, though we may be unable to trace them. The vulgar, in all countries, perhaps, have a propensity to imagine, that, after a certain number of years, the succession of plentiful and of scanty harvests begins again to be repeated in the same *series* as before; a notion to which Lord Bacon himself has given some countenance in the following passage. "There is a toy which I have heard, and I would not have it given over, but waited upon a little. They say it is observed in the low countries, (I know not in what part) that every five and thirty years, the same kind and suite of years and weathers comes about again; as great frosts, great wet, great droughts, warm winters, summers with little heat, and the like; and they call it *the prime.* It is a thing I do the rather mention, because computing backwards, I have found some concurrence."*

Among the philosophers of antiquity, the influence of the same prejudice is observable on a scale still greater; many of them having supposed, that at the end of the *annus magnus*, or Platonic year, a repetition would commence of all the transactions that have occurred on the theatre of the world. According to this doctrine the predictions in Virgil's Pollio, will, sooner or later, be literally accomplished:

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* Essays, Art. 58.

> "Alter erit tum Tiphys, et altera quæ vehat Argo
> Delectos Heroas; erunt etiam altera bella;
> Atque iterum ad Trojam magnus mittetur Achilles."*

The astronomical cycles which the Greeks borrowed from the Egyptians and Chaldeans, when combined with that natural bias of the mind which I have just remarked, account sufficiently for this extension to the moral world, of ideas suggested by the order of physical phenomena.

Nor is this hypothesis of a *moral cycle*, extravagant as it unquestionably is without its partisans among modern theorists. The train of thought, indeed, by which they have been led to adopt it is essentially different; but it probably received no small degree of countenance, in their opinion, from the same bias which influenced the speculations of the ancients. It has been demonstrated by one of the most profound mathematicians of the present age,† that all the irregularities arising from the mutual action of the planets, are, by a combination of various arrangements, necessarily subjected to certain periodical laws, so as for ever to secure the stability and order of the system. Of this sublime conclusion, it has been justly and beautifully observed, that "after Newton's theory of the elliptic orbits of the planets, La Grange's discovery of their periodical inequalities, is, without doubt, the noblest truth in physical astronomy; while, in respect of the doctrine of final causes, it may truly be regarded as the greatest of all."* The theorists, however, to whom I at present allude, seem disposed to consider it in a very different light, and to employ it for purposes of a very different tendency. "Similar periods (it has been said) but of an extent that affright the imagination, probably regulate the modifications of the atmosphere; inasmuch as the same series of appearances must inevitably recur, whenever a coincidence of circumstances takes place. The aggregate labours of men, indeed, may be supposed, at first sight, to alter the operation of natural causes, by continually transforming the face of our globe; but it must be recollected that, as the agency of animals is itself stimulated and determined solely by the influence of external objects, the re-actions of living beings are comprehended in the same necessary system; and, consequently, that all the events within the immeasurable circuit of the universe, are the successive evolution of an extended series, which, at the returns of some vast period, repeats its eternal round during the endless flux of time."†

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* "Tum efficitur (says Cicero, speaking of his period) cum solis et lunæ, et quinque errantium ad eandem inter se comparationem confectis omnium spatiis, est facta conversio. Quæ quàm longa sit, magna quæstio est: *esse vero certam et definitam necesse est.*" (*De Nat. Deorum.* Lib. ii. 74.) "Hoc intervallo (Clavius observes) quidam volunt, omnia quæcunque in mundo sunt, eodem ordine esse reditura, quo nunc cernuntur." (*Clav. Commentar. in Sphæram Joannis de Sacro Bosco*, p. 57. Romæ, 1607.)

† M. De la Grange.

On this very bold argument, considered in its connexion with the scheme of necessity, I have nothing to observe here. I have mentioned it merely as an additional proof of that irresistible propensity to believe in the permanent order of physical events, which seems to form an original principle of the human constitution;—a belief essential to our existence in the world which we inhabit, as well as the foundation of all physical science; but which we obviously extend far beyond the bounds authorized by sound philosophy, when we apply it, without any limitation, to that moral system, which is distinguished by peculiar characteristics, so numerous and important, and for the accommodation of which, so many reasons entitle us to presume, that the material universe, with all its constant and harmonious laws, was purposely arranged.

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* Edinburgh Review, Vol. XI. 264.

† The foregoing passage is transcribed from an article in the *Monthly Review*. I have neglected to mark the volume; but I think it is one of those published since 1800. See Note (I.)

To a hasty and injudicious application of the same belief, in anticipating the future course of human affairs, might be traced a variety of popular superstitions, which have prevailed, in a greater or less degree, in all nations and ages; and those superstitions, for example, which have given rise to the study of charms, of omens, of astrology, and of the different arts of divination. But the argument has been already prosecuted as far as its connexion with this part of the subject requires. For a fuller illustration of it, I refer to some remarks in my former volume, on the superstitious observances which, among rude nations, are constantly found blended with the practice of physic; and which, contemptible and ludicrous as they seem, have an obvious foundation, during the infancy of human reason, in those important principles of our nature, which, when duly disciplined by a more enlarged experience, lead to the sublime discoveries of inductive science.

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* Vol. I. pp. 355, 356, 357, 3d edit.

Nor is it to the earlier stages of society, or to the lower classes of the people, that these superstitions are confined. Even in the most enlightened and refined periods they occasionally appear; exercising, not unfrequently, over men of the highest genius and talents, an ascendant, which is at once consolatory and humiliating to the species.

"Ecce fulgurum monitus, oraculorum præscita, aruspicum prædicta, atque etiam, parva dictu in auguriis sternutamenta et offensiones pedum. Divus Augustus lævum prodidit sibi calceum præpostere inductum, quo die seditione militari prope afflictus est."*

"Dr. Johnson (says his affectionate and very communicative biographer) had another particularity, of which none of his friends ever ventured to ask an explanation. It appeared to me some superstitious habit, which he had contracted early, and from which he had never called upon his reason to disentangle him. This was, his anxious care to go out or in at a door or passage, by a certain number of steps from a certain point, or at least so as that either his right or his left foot (I am not certain which) should constantly make the first actual movement when he came close to the door or passage. Thus I conjecture: for I have, upon innumerable occasions, observed him suddenly stop, and then seem to count his steps with a deep earnestness; and when he had neglected or gone wrong in this sort of magical movement, I have seen him go back again, put himself in a proper posture to begin the ceremony, and having gone through it, break from his abstraction, walk briskly on, and join his companion."*

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* Plin. Nat. Hist. Lib. ii.

The remark may appear somewhat out of place, but after the last quotation, I may be permitted to say, that the person to whom it relates, great as his powers, and splendid as his accomplishments undoubtedly were, was scarcely entitled to assert, that "Education is as well known, and has long been as well known, as ever it can be."† What a limited estimate of the objects of education must this great man have formed! They who know the value of a well-regulated and unclouded mind, would not incur the weakness and wretchedness exhibited in the foregoing description, for all his literary acquirements and literary fame.

III.

Continuation of the Subject.—General Remarks on the Difference between the Evidence of Experience, and that of Analogy.

According to the account of experience which has been hitherto given, its evidence reaches no farther than to an anticipation of the future from the past, in cases where the same physical cause continues to operate in exactly the same circumstances. That this statement is agreeable to the strict philosophical notion of experience, will not be disputed. Wherever a change takes place, either in the cause itself, or in the circumstances combined with it in our former trials, the anticipations which we form of the future cannot with propriety be referred to experience alone, but to experience co-operating with some other principles of our nature. In common discourse, however, precision in the use of language is not to be expected, where logical or metaphysical ideas are at all concerned; and, therefore, it is not to be wondered at, that the word experience should often be employed with a latitude greatly beyond what the former definition authorizes. When I transfer, for example, my conclusions concerning the descent of heavy bodies from one stone to another stone, or even from a stone to a leaden bullet, my inference might be said, with sufficient accuracy for the ordinary purposes of speech, to have the evidence of experience in its favour; if indeed it would not savour of scholastic affectation to aim at a more rigorous enunciation of the proposition. Nothing, at the same time, can be more evident than this, that the slightest shade of difference which tends to weaken the resemblance, or rather to destroy the identity of two cases, invalidates the inference from the one to the other, as far as it rests on experience solely, no less than the most prominent dissimilitudes which characterize the different kingdoms and departments of nature.

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* Boswell's Johnson, Vol. I. p. 264, 4to edit. † Ibid. p. 514.

Upon what ground do I conclude that the thrust of a sword through my body, in a particular direction, would be followed by instant death? According to the popular use of language, the obvious answer would be,—upon experience, and experience alone. But surely this account of the matter is extremely loose and incorrect; for where is the evidence that the internal structure of *my* body bears any resemblance to that of any of the other bodies which have been hitherto examined by anatomists? It is no answer to this question to tell me, that the experience of these anatomists has ascertained a uniformity of structure in every human subject which has as yet been dissected; and that therefore I am justified in concluding that *my* body forms no exception to the general rule. My question does not relate to the soundness of this inference, but to the principle of my nature, which leads me thus not only to reason from the past to the future, but to reason from one thing to another, which, in its external marks, bears a certain degree of resemblance to it. Something more than experience, in the strictest sense of that word, is surely necessary to explain the transition from what is identically the same, to what is only similar; and yet my inference in this instance is made with the most assured and unqualified confidence in the infallibility of the result. No inference, founded on the most direct and long-continued experience, nor indeed any proposition established by mathematical demonstration, could more imperiously command my assent.

In whatever manner the province of experience, strictly so called, comes to be thus enlarged, it is perfectly manifest, that without some provision for this purpose, the principles of our constitution would not have been duly adjusted to the scene in which we have to act. Were we not so formed as eagerly to seize the resembling features of different things and different events, and to extend our conclusions from the individual to the species, life would elapse before we had acquired the first rudiments of that knowledge which is essential to the preservation of our animal existence.

This step in the history of the human mind has been little, if at all, attended to by philosophers; and it is certainly not easy to explain in a manner completely satisfactory, how it is made. The following hints seem to me to go a considerable way towards a solution of the difficulty.

It is remarked by Mr. Smith, in his considerations on the Formation of Languages, that the origin of genera and species, which is commonly represented in the schools as the effect of an intellectual process peculiarly mysterious and unintelligible, is a natural consequence of our disposition to transfer to a new object the name of any other familiar object which possesses such a degree of resemblance to it, as to serve the memory for an associating tie between them. It is in this manner, he has shown, and not by any formal or scientific exercise of abstraction, that, in the infancy of language, proper names are gradually transformed into appellatives; or, in other words, that individual things come to be referred to classes or assortments.*

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* A writer of great learning and ability (Dr. Magee of Dublin) who has done me the honour to animadvert on a few passages of my works, and who has softened his criticisms by some expressions of regard, by which I feel myself highly flattered, has started a very acute objection to this theory of Mr. Smith, which I think it incumbent on me to submit to my readers, in his own words. As the quotation, however, with the remarks which I have to offer upon it, would extend to too great a length to be introduced here, I must delay entering on the subject till the end of this volume. See Note (K.)

This remark becomes, in my opinion, much more luminous and important, by being combined with another very original one, which is ascribed to Turgot by Condorcet, and which I do not recollect to have seen taken notice of by any later writer on the human mind. According to the common doctrine of logicians, we are led to suppose that our knowledge begins in an accurate and minute acquaintance with the characteristical properties of individual objects; and that it is only by the slow exercise of comparison and abstraction, that we attain to the notion of classes or *genera*. In opposition to this idea, it was a maxim of Turgot's, that some of our most abstract and general notions are among the earliest which we form.* What meaning he annexed to this maxim, we are not informed; but if he understood it in the same sense in which I am disposed to interpret it, he appears to me entitled to the credit of a very valuable suggestion with respect to the natural progress of human knowledge. The truth is, that our first perceptions lead us invariably to confound together things which have very little in common; and that the specifical differences of individuals do not begin to be marked with precision till the powers of observation and reasoning have attained to a certain degree of maturity. To a similar indistinctness of perception are to be ascribed the mistakes about the most familiar appearances which we daily see committed by those domesticated animals with whose instincts and habits we have an opportunity of becoming intimately acquainted. As an instance of this, it is sufficient to mention the terror which a horse sometimes discovers in passing, on the road, a large stone, or the waterfall of a mill.

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* "M. Turgot croyoit qu'on s'étoit trompé en imaginant qu'en général l'esprit n'acquiert des idées générales ou abstraites que par la comparaison d'idées plus particulières. Au contraire, nos premières idées sont très-générales, puisque ne voyant d'abord qu'un petit nombre de qualités, notre idée renferme tous les êtres auxquels ces qualités sont communes. En nous éclairant, en examinant davantage, nos idées deviennent plus particulières sans jamais atteindre le dernier terme! et ce qui a pu tromper les métaphysiciens, c'est qu'alors précisément nous apprenons que ces idées sont plus générales que nous ne l'avions d'abord supposé."—*Vie de Turgot*, p. 189. Berne, 1787.

I have searched in vain for some additional light on this interesting hint, in the complete edition of Turgot's works, published at Paris in 1808.

Notwithstanding, however, the justness of this maxim, it is nevertheless true, that every scientific classification must be founded on an examination and comparison of individuals. These individuals must, in the first instance, have been observed with accuracy, before their specific characteristics could be rejected from the generic description, so as to limit the attention to the common qualities which it comprehends. What are usually called *general ideas* or *general notions*, are therefore of two kinds, essentially different from each other; those which are *general*, merely from the vagueness and imperfection of our information; and those which have been methodically *generalised*, in the way explained by logicians, in consequence of an abstraction founded on a careful study of particulars. Philosophical precision requires, that two sets of notions, so totally dissimilar, should not be confounded together; and an attention to the distinction between them will be found to throw much light on various important steps in the natural history of the mind.*

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* The distinction above stated, furnishes what seems to me the true answer to an argument which Charron, and many other writers since his time, have drawn, in proof of the reasoning powers of brutes, from the univer-

One obvious effect of the grossness and vagueness in the perceptions of the inexperienced observer must necessarily be to identify, under the same common appellations, immense multitudes of individuals, which the philosopher will afterwards find reason to distinguish carefully from each other; and as language, by its unavoidable reaction on thought, never fails to restore to it whatever imperfections it has once received, all the indistinctness which, in the case of individual observers, originated in an ill-informed judgment, or in a capricious fancy, comes afterwards, in succeeding ages, to be entailed on the infant understanding, in consequence of its incorporation with vernacular speech. These confused apprehensions produced by language must, it is easy to see, operate exactly in the same way as the undistinguishing perceptions of children or savages; the familiar use of a generic word, insensibly and irresistibly leading the mind to extend its conclusions from the individual to the genus, and thus laying the foundation of conclusions and anticipations which we suppose to rest on experience, when, in truth, experience has never been consulted.

sal conclusions which they appear to found on the observation of particulars. "Les bestes des singuliers concluent les universels, du regard d'un homme seul cognoissent tous hommes," &c. &c. *De la Sagesse*, Lib. I. Chap. 8.

Instead of saying, that brutes generalize things, which are similar, would it not be nearer the truth to say, that they confound things which are different?

Many years after these observations were written, I had the satisfaction to meet with the following experimental confirmation of them, in the Abbé Sicard's Course of Instruction for the Deaf and Dumb; "J'avois remarqué que Massieu donnoit plus volontiers le même nom, un nom commun, à plusieurs individus dans lesquels il trouvoit des traits de ressemblance; les noms individuels supposoient des differences qu'il n'étoit pas encore temps de lui faire observer." (*Sicard*, pp. 30, 31.) The whole of the passage is well worth consulting.

In all such instances, it is worthy of observation, we proceed ultimately on the common principle,—that in similar circumstances, the same cause will produce the same effects; and when we err, the source of our error lies merely in identifying different cases which ought to be distinguished from each other. Great as may be the occasional inconvenences arising from this general principle thus misapplied, they bear no proportion to the essential advantages resulting from the disposition in which they originate to arrange and to classify; a disposition on which (as I have elsewhere shown,) the intellectual improvement of the species in a great manner hinges. That the constitution of our nature in this respect is, on the whole, wisely ordered, as well as perfectly conformable to the general economy of our frame, will appear from a slight survey of some other principles, nearly allied to those which are at present under our consideration.

It has been remarked by some eminent writers in this part of the island,* that our expectation of the continuance of the laws of nature has a very close affinity to our faith in human testimony. The parallel might perhaps be carried, without any over-refinement, a little farther than these writers have attempted; inasmuch as, in both cases, the instinctive principle is in the first instance unlimited, and requires, for its correction and regulation, the lessons of subsequent experience. As the credulity of children is originally without bounds, and is afterwards gradually checked by the examples which they occasionally meet of human falsehood, so, in the infancy of our knowledge, whatever objects or events present to our senses a strong resemblance to each other, dispose us, without any very accurate examination of the minute details by which they may be really discriminated, to conclude with eagerness, that the experiments and observations which we make with respect to one individual, may be safely extended to the whole class. It is experience alone that teaches us caution in such inferences, and subjects the natural principle to the discipline prescribed by the rules of induction.

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* See Reid's Inquiry into the Human Mind, Chap. VI. Sect. 24. Campbell's Dissertation on Miracles, Part I. Sect. 1. Smith's Theory of Moral Sentiments, Vol. II. p. 382, sixth edition.

It must not, however, be imagined, that, in instances of this sort, the instinctive principle always leads us astray; for the analogical anticipations which it disposes us to form, although they may not stand the test of a rigorous examination, may yet be sufficiently just for all the common purposes of life. It is natural, for example, that a man who has been educated in Europe should expect, when he changes his residence to any of the other quarters of the globe, to see heavy bodies fall downwards, and smoke to ascend, agreeably to the general laws to which he has been accustomed; and that he should take for granted, in providing the means of his subsistence, that the animals and vegetables which he has found to be salutary and nutritious in his native regions, possess the same qualities wherever they exhibit the same appearances. Nor are such expectations less useful than natural; for they are completely realized, as far as they minister to the gratification of our more urgent wants. It is only when we begin to indulge our curiosity with respect to those nicer details which derive their interest from great refinement in the arts, or from a very advanced state of physical knowledge, that we discover our first conclusions, however just in the main, not to be mathematically exact; and are led by those habits which scientific pursuits communicate, to investigate the difference of circumstances to which the variety in the result is owing. After having found that heavy bodies fall downwards at the equator as they do in this island, the most obvious, and perhaps, on a superficial view of the question, the most reasonable inference would be, that the same pendulum which swings seconds at London, will vibrate at the same rate under the line. In this instance, however, the theoretical inference is contradicted by the fact;—but the contradiction is attended with no practical inconvenience to the multitude, while, in the mind of the philosopher, it only serves to awaken his attention to the different circumstances of the two cases, and, in the last result, throws a new lustre on the simplicity and uniformity of that law, from which it seemed, at first sight, an anomalous deviation.

To this uniformity in the laws which regulate the order of physical events, there is something extremely similar in the systematical regularity (subject indeed to many exceptions) which, in every language, however imperfect, runs through the different classes of its words, in respect of their inflexions, forms of derivation, and other verbal filiations or affinities. How much this regularity or *analogy* (as it is called by grammarians) contributes to facilitate the acquisition of dead and foreign languages, every person, who has received a liberal education, knows from his own experience. Nor is it less manifest, that the same circumstance must contribute powerfully to aid the memories of children in learning to speak their mother-tongue. It is not my present business to trace the principles in the human mind by which it is produced. All that I would remark is, the very early period at which it is seized by children; as is strongly evinced by their disposition to push it a great deal too far, in their first attempt towards speech. This disposition seems to be closely connected with that which leads them to repose faith in testimony: and it also bears a striking resemblance to that which prompts them to extend their past experience to those objects and events of which they have not hitherto had any means of acquiring a direct knowledge. It is probable, indeed, that our expectation, in all these cases, has its origin in the same common principles of our nature: and it is certain that, in all of them, it is subservient to the important purpose of facilitating the progress of the mind. Of this, nobody can doubt, who considers for a moment, that the great end to be first accomplished, was manifestly the communication of the *general rule;* the acquisition of the exceptions (a knowledge of which is but of secondary importance) being safely entrusted to the growing diligence and capacity of the learner.

The considerations now stated, may help us to conceive in what manner conclusions derived from experience come to be insensibly extended from the individual to the species: partly in consequence of the gross and undistinguishing nature of our first perceptions, and partly in consequence of the magical influence of a common name. They seem also to show, that this natural process of thought, though not always justified by a sound logic, is not without its use in the infancy of human knowledge.

In the various cases which have been hitherto under our review, our conclusions are said in popular, and even in philosophical language, to be founded on experience. And yet the truth unquestionably is, (as was formerly observed) that the evidence of experience reaches no farther than to an anticipation of the future from the past, in instances where the same cause continues to operate in circumstances exactly similar. How much this vagueness of expression must contribute to mislead us in many of our judgments, will afterwards appear.

The observations which I have to offer upon analogy, considered as a ground of scientific conjecture and reasoning, will be introduced with more propriety in a future chapter.

IV.

Continuation of the Subject.—Evidence of Testimony tacitly recognized as a Ground of Belief, in our most certain conclusions concerning contingent Truths.—Difference between the Logical and the Popular Meaning of the word Probability.

In some of the conclusions which have been already under our consideration with respect to contingent truths, a species of evidence is admitted, of which no mention has hitherto been made; I mean the evidence of *testimony*. In astronomical calculations, for example, how few are the instances in which the *data* rest on the evidence of our own senses; and yet our confidence in the result, is not, on that account, in the smallest degree weakened.

On the contrary, what certainty can be more complete, than that with which we look forward to an eclipse of the sun or the moon, on the faith of elements and of computations which we have never verified, and for the accuracy of which we have no ground of assurance whatever, but the scientific reputation of the writers from whom we have borrowed them. An astronomer who should affect any scepticism with respect to an event so predicted, would render himself no less an object of ridicule, than if he were disposed to cavil about the certainty of the sun's rising to-morrow.

Even in pure mathematics, a similar regard to testimony, accompanied with a similar faith in the faculties of others, is by no means uncommon. Who would scruple, in a geometrical investigation, to adopt, as a link in the chain, a theorem of Appollonius or of Archimedes, although he might not have leisure at the moment, to satisfy himself, by an actual examination of their demonstrations, that they had been guilty of no paralogism, either from accident or design, in the course of their reasonings?

In our anticipations of astronomical phenomena, as well as in those which we form concerning the result of any familiar experiment in physics, philosophers are accustomed to speak of the event as only *probable;* although our confidence in its happening is not less complete, than if it rested on the basis of mathematical demonstration. The word *probable,* therefore, when thus used, does not imply any *deficiency* in the proof, but only marks the particular nature of that proof, as contradistinguished from another species of evidence. It is opposed, not to what is *certain,* but to what admits of being *demonstrated after* *the manner of mathematicians.* This differs widely from the meaning annexed to the same word in popular discourse; according to which, whatever event is said to be *probable,* is understood to be expected with some degree of doubt. *As certain as death—as certain as the rising of the sun*—are proverbial modes of expression in all countries; and they are, both of them, borrowed from events which, in philosophical language, are only probable or contingent. In like manner, the existence of the city of Pekin, and the reality of Cesar's assassination, which the philosopher classes with *probabilities,* because they rest solely upon the evidence of testimony, are universally classed with *certainties* by the rest of mankind; and in any case but the statement of a logical theory, the application to such truths of the word *probable,* would be justly regarded as an impropriety of speech. This difference between the technical meaning of the word *probability,* as employed by logicians, and the notion usually attached to it in the business of life; together with the erroneous theories concerning the nature of demonstration, which I have already endeavoured to refute,—have led many authors of the highest name, in some of the most important arguments which can employ human reason, to overlook that irresistible evidence which was placed before their eyes, in search of another mode of proof altogether unattainable in moral inquiries, and which, if it could be attained, would not be less liable to the cavils of sceptics.

But although, in philosophical language, the epithet *probable* be applied to events which are acknowledged to be *certain,* it is also applied to those events which are called [illegible] by the vulgar. The philosophical meaning of the word, therefore, is more *comprehensive* than the popular; the former denoting that particular *species* of evidence of which contingent truths admit; the latter being confined to such *degrees* of this evidence as fall short of the highest. These different degrees of *probability* the philosopher considers as a *series*, beginning with bare possibility, and terminating in that apprehended *infallibility*, with which the phrase *moral certainty* is synonymous. To this last term of the *series*, the word *probable* is, in its ordinary acceptation, plainly inapplicable.

The satisfaction which the astronomer derives from the exact coincidence, in point of time, between his theoretical predictions concerning the phenomena of the heavens, and the corresponding events when they actually occur, does not imply the smallest doubt, on *his* part, of the constancy of the laws of nature. It resolves partly into the pleasure of arriving at the knowledge of the same truth or of the same fact by different *media*; but, chiefly, into the gratifying assurance which he thus receives, of the correctness of his principles, and of the competency of the human faculties to these sublime investigations. What exquisite delight must La Place have felt, when, by deducing from the theory of gravitation, the cause of the acceleration of the moon's mean motion—an acceleration which proceeds at the rate of little more than 11″ in a century,—he accounted, with such mathematical precision, for all the recorded observations of her place from the infancy of astronomical science! It is from the length and abstruseness, however, of the reasoning process, and from the powerful effect produced on the imagination, by a *calculus* which brings into immediate contrast with the immensity of time, such evanescent elements as the fractional parts of a second, that the coincidence between the computation and the event appears in this instance so peculiarly striking. In other respects, our confidence in the future results rests on the same principle with our expectation that the sun will rise to-morrow at a particular instant; and, accordingly, now that the correctness of the theory has been so wonderfully verified by a comparison with facts, the one event is expected with no less assurance than the other.

With respect to those inferior degrees of *probability* to which, in common discourse, the meaning of that word is exclusively confined, it is not my intention to enter into any discussions. The subject is of so great extent, that I could not hope to throw upon it any lights satisfactory either to my reader or to myself, without encroaching upon the space destined for inquiries more intimately connected with the theory of our reasoning powers. One set of questions, too, arising out of it, (I mean those to which mathematical calculations have been applied by the ingenuity of the moderns) involve some very puzzling metaphysical difficulties,* the consideration of which would completely interrupt the train of our present speculations. I proceed, therefore, in continuation of those in which we have been lately engaged, to treat other topics of a more general nature, tending to illustrate the logical procedure of the mind in the discovery of scientific truth. As an introduction to these, I propose to devote one whole chapter to some miscellaneous strictures and reflections on the logic of the schools.

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* I allude more particularly to the *doubts* started on this subject by D'Alembert, in his Opuscules Mathématiques; and in his Mélanges de Littérature.

CHAPTER THIRD.

OF THE ARISTOTELIAN LOGIC.

SECTION I.

Of the Demonstrations of the Syllogistic Rules given by Aristotle and his Commentators.

THE great variety of speculations which, in the present state of science, the Aristotelian logic naturally suggests to a philosophical inquirer, lays me, in this chapter, under the necessity of selecting a few leading questions, bearing immediately upon the particular objects which I have in view. In treating of these, I must, of course, suppose my readers to possess some previous acquaintance with the subject to which they relate; but it is only such a *general* knowledge of its outlines and phraseology, as, in all universities, is justly considered as an essential accomplishment to those who receive a liberal education.

I begin with examining the pretensions of the Aristotelian logic to that pre-eminent rank which it claims among the sciences; professing, not only to rest all its conclusions on the immoveable basis of demonstration, but to have reared this mighty fabric on the narrow ground-work of a single axiom. "On the basis (says the latest of his commentators) of one simple truth, Aristotle has reared a lofty and various structure of abstract science, clearly expressed and fully demonstrated."[*] Nor have these claims been disputed by mathematicians themselves. "In logica (says Dr. Wallis) structura syllogismi demonstratione nititur pure mathematicâ."[†] And, in another passage: "Sequitur institutio logica, communi usui accommodata,—Quo videant Tirones, syllogismorum leges strictissimis demonstrationibus plane mathematicis ita fundatas, ut consequentias habeant irrefragabiles, quæque offuciis fallaciisque detegendis sint accommodatæ."[‡] Dr. Reid, too, although he cannot be justly charged, on the whole, with any undue reverence for the authority of Aristotle, has yet, upon one occasion, spoken of his *demonstrations* with much more respect than they appear to me entitled to. "I believe (says he) it will be difficult, in any science, to find so large a system of truths of so very abstract and so general a nature, all fortified by demonstration, and all invented and perfected by one man. It shows a force of genius, and labour of investigation, equal to the most arduous attempts."[§]

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[*] Analysis of Aristotle's Works by Dr. Gillies, Vol. I. p. 83, 2d edit.

[†] See the *Monitum* prefixed to the Miscellaneous Treatises annexed to the third Volume of Dr. Wallis's Mathematical Works.

[‡] Preface to the same volume.

[§] Analysis of Aristotle's Logic.

That Dr. Reid, however, was perfectly aware that these demonstrations are more specious than solid, may be safely inferred from a sentence which afterwards occurs in the same tract. "When we go without the cir-

As the fact which is so confidently assumed in these passages would, if admitted, completely overturn all I have hitherto said concerning the nature both of axioms and of demonstrative evidence, the observations which follow seem to form a necessary sequel to some of the preceding discussions. I acknowledge, at the same time, that my chief motive for introducing them, was a wish to counteract the effect of those triumphant panegyrics upon Aristotle's Organon, which of late have been pronounced by some writers, whose talents and learning justly add much weight to their literary opinions; and an anxiety to guard the rising generation against a waste of time and attention, upon a study so little fitted, in my judgment, to reward their labour.

The first remark which I have to offer upon Aristotle's demonstrations, is, That they proceed on the obviously false supposition of its being possible to add to the conclusiveness and authority of demonstrative evidence. One of the most remarkable circumstances which distinguishes this from that species of evidence which is commonly called moral or probable, is, that it is not susceptible of degrees; the process of reasoning of which it is the result, being either good for nothing, or so perfect and complete in itself, as not to admit of support from any adventitious aid. Every such process of reasoning, it is well known, may be resolved into a series of legitimate syllogisms, exhibiting separately and distinctly, in a light as clear and strong as language can afford, each successive link of the

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cle of the mathematical sciences, I know nothing in which there *seems* to be so much demonstration as in that part of logic which treats of the figures and modes of syllogisms."

demonstration. How far this conduces to render the demonstration more convincing than it was before, is not now the question. Some doubts may reasonably be entertained upon this head, when it is considered, that, among the various expedients employed by mathematical teachers to assist the apprehension of their pupils, none of them have ever thought of resolving a demonstration (as may always be easily done) into the syllogisms of which it is composed.[*] But, abstracting altogether from this consideration, and granting that a demonstration may be rendered more manifest and satisfactory by being syllogistically stated; upon what principle can it be supposed possible, after the demonstration has thus been analyzed and expanded, to enforce and corroborate, by any subsidiary reasoning, that irresistible conviction which demonstration necessarily commands.

It furnishes no valid reply to this objection, to allege, that mathematicians often employ themselves in inventing different demonstrations of the same theorem; for, in such instances, their attempts do not proceed from any anxiety to swell the mass of evidence, by finding (as in some other sciences) a variety of collateral arguments, all bearing, with their combined force, on the same truth;—their only wish is, to discover the easiest and shortest road by which the truth may be reached. In point of simplicity, and of what geometers call *elegance,* these various demonstrations may differ widely from each other; but in point of sound logic, they are all precisely on the same footing. Each of them shines with its own intrinsic light alone; and the first which occurs (provided they be all equally understood) commands the assent not less irresistibly than the last.

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[*] From a passage indeed in a memoir by Leibnitz, (printed in the sixth volume of the Acta Eruditorum) it would seem, that a commentary of this kind on the first six books of Euclid, had been actually carried into execution by two writers, whose names he mentions. "Firma autem demonstratio est, quæ præscriptam a logica formam servat, non quasi semper ordinatis scholarum more syllogismis opus sit (quales *Christianus Herlinus* et *Conradus Dasypodius* in sex priores Euclidis libros exhibuerunt) sed ita saltem ut argumentatio concludat vi formæ," &c. &c. *Acta Eruditor*. Lips. Vol. I. p. 285. Venet. 1740.

I have not seen either of the works alluded to in the above sentence; and, upon less respectable authority, should scarcely have conceived it to be credible, that any person, capable of understanding Euclid, had ever seriously engaged in such an undertaking. It would have been difficult to devise a more effectual expedient for exposing, to the meanest understanding, the futility of the syllogistic theory.

The idea, however, on which Aristotle proceeded, in attempting to fortify one demonstration by another, bears no analogy whatever to the practice of mathematicians in multiplying proofs of the same theorem; nor can it derive the slightest countenance from their example. His object was not to teach us how to demonstrate the same thing in a variety of different ways; but to demonstrate, by abstract reasoning, the conclusiveness of demonstration. By what means he set about the accomplishment of his purpose, will afterwards appear. At present, I speak only of his *design;* which, if the foregoing remarks be just, it will not be easy to reconcile with correct views, either concerning the nature of evidence, or the theory of the human understanding.

For the sake of those who have not previously turned their attention to Aristotle's Logic, it is necessary, before proceeding farther, to take notice of a peculiarity (and, as appears to me, an impropriety,) in the use which he makes of the epithets *demonstrative* and *dialectical*, to mark the distinction between the two great classes into which he divides syllogisms; a mode of speaking which, according to the common use of language, would seem to imply, that one species of syllogisms may be more conclusive and cogent than another. That this is not the case, is almost self-evident; for, if a syllogism be perfect *in form*, it must, of necessity, be not only conclusive, but demonstratively conclusive. Nor is this, in fact, the idea which Aristotle himself annexed to the distinction; for he tells us, that it does not refer to the *form* of syllogisms, but to their *matter*;—or, in plainer language, to the degree of evidence accompanying the *premises* on which they proceed.* In the two books of his last Analytics, accordingly, he treats of syllogisms which are said to be demonstrative, because their premises are certain; and in his Topics, of what he calls dialectical syllogisms, because their premises are only probable. Would it not have been a clearer and juster mode of stating this distinction, to have applied the epithets *demonstrative* and *dialectical* to the truth of the *conclusions* resulting from these two classes of syllogisms, instead of applying them to the syllogisms themselves? The phrase *demonstrative syllogism* certainly seems, at first sight, to express rather the complete and necessary connexion between the conclusion and the premises, than the certainty or the necessity of the truths which the premises assume.

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* To the same purpose also Dr. Wallis: "Syllogismus *Topicus* (qui et *Dialecticus* dici solet) talis haberi solet syllogismus (seu syllogismorum series) qui firmam potius præsumptionem, seu opinionem valde probabilem creat, quam absolutam certitudinem. Non quidem ratione *Formæ*, (nam syllogismi omnes, si in justa forma, sunt demonstrativi; hoc est, si præmissæ veræ sint, vera erit et conclusio,) sed ratione *Materiæ*, seu *Præmissarum;* quæ ipsæ, utplurimum, non sunt absolute certæ, et universaliter veræ; sed saltem probabiles, atque utplurimum veræ." *Wallis, Logica*, Lib. iii. cap. 23.

To this observation it may be added, (in order to prevent any misapprehensions from the ambiguity of language,) that Aristotle's idea of the nature of demonstration, is essentially different from that which I have already endeavoured to explain. "In all demonstration," (says Dr. Gillies, who, in this instance, has very accurately and clearly stated his author's doctrine,) "the first principles must be necessary, immutable, and therefore eternal truths, because those qualities could not belong to the conclusion, unless they belonged to the premises, which are its causes."* According to the account of de-

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* Aristotle's Ethics and Politics, &c. By Dr. Gillies. Vol. I. p. 96.

I am much at a loss how to reconcile this account of demonstrative evidence with the view which is given by Dr. Gillies of the nature of syllogism, and of the principles on which the syllogistic theory is founded. In one passage (p. 81.) he tells us, that "Aristotle invented the syllogism, to prevent imposition arising from the abuse of words;" in a second, (p. 83.) that "the simple truth on which Aristotle has reared a lofty and various structure of abstract science, clearly expressed and *fully demonstrated*—is itself founded in the natural and universal texture of language:" in a third, (p. 86.) that "the doctrines of Aristotle's Organon have been strangely perplexed by confounding *the grammatical principles on which that work is built* with mathematical axioms." Is it possible to suppose, that Aristotle could have ever thought of applying to mere *grammatical principles*,—to *truths founded in the natural and universal texture of language*—the epithets of *necessary*, *immutable*, and *eternal?*

I am unwilling to lengthen this note, otherwise it might be easily shown, how utterly irreconcileable, in the present instance, are the glosses of this ingenious commentator with the text of his author. Into some of these glosses it is probable that he has been unconsciously betrayed, by his anxiety to establish the claim of his favourite philosopher to the important speculamonstrative or mathematical evidence formerly given, the first principles on which it rests are not eternal and immutable truths, but definitions or hypotheses; and therefore, if the epithet demonstrative be understood, in our present argument, as descriptive of that peculiar kind of evidence which belongs to mathematics, the distinction between demonstrative and dialectical syllogisms is reduced to this; that in the former, where all that is asserted is the necessary connexion between the conclusion and the premises, neither the one nor the other of these can with propriety be said to be either *true* or *false*, because both of them are entirely hypothetical: in the latter, where the premises are meant to express truths or facts, (supported, on the most favourable supposition, by a very high degree of probability,) the conclusion must necessarily partake of that uncertainty in which the premises are involved.

But what I am chiefly anxious at present to impress on the minds of my readers, is the substance of the two following propositions: *First*, That dialectical syllogisms (provided they be not sophistical) are not less demonstratively conclusive, *so far as the process of reasoning is concerned*, than those to which this latter epithet is restricted by Aristotle; and, *secondly*, That *it is to the process of reasoning alone*, and not to the premises on which it proceeds, that Aristotle's demonstrations exclusively refer. The sole object, therefore, of these demonstrations, is (as I already remarked) not to strengthen, by new proofs, principles which were doubtful, or to supply

tions of Locke on the abuse of words, and to those of some later writers on language considered as an instrument of thought.

new links to a chain of reasoning which was imperfect, but to confirm one set of demonstrations by means of another. The mistakes into which some of my readers might have been led by the contrast which Aristotle's language implies between dialectical syllogisms, and those which he honours with the title of demonstrative, will, I trust, furnish a sufficient apology for the length of this explanation.

Having enlarged so fully on the professed aim of Aristotle's demonstrations, I shall despatch, in a very few pages, what I have to offer on the manner in which he has carried his design into effect. If the design be as unphilosophical as I have endeavoured to show that it is, the apparatus contrived for its execution can be considered in no other light than as an object of literary curiosity. A process of reasoning which pretends to demonstrate the legitimacy of a conclusion which, of itself, by its own intrinsic evidence, irresistibly commands the assent, must, we may be perfectly assured, be at bottom unsubstantial and illusory, how specious soever it may at first sight appear. Supposing all its inferences to be strictly just, it can only bring us round again to the point from whence we set out.

The very acute strictures of Dr. Reid, in his Analysis of Aristotle's Logic, on this part of the Syllogistic Theory, render it superfluous for me, on the present occasion, to enter into any details upon the subject. To this small, but valuable tract, therefore, I beg leave to refer my readers; contenting myself with a short extract, which contains a general and compendious view of the conclusion drawn, and of the argument used, to prove it, in each of the three figures of syllogisms.

"In the first figure, the conclusion affirms or denies something of a certain species or individual; and the argument to prove this conclusion is, That the same thing may be affirmed or denied of the whole genus to which that species or individual belongs.

"In the second figure, the conclusion is, That some species or individual does not belong to such a genus; and the argument is, That some attribute common to the whole genus does not belong to that species or individual.

"In the third figure, the conclusion is, That such an attribute belongs to part of a genus; and the argument is, That the attribute in question belongs to a species or individual which is part of that genus.

"I apprehend that, in this short view, every conclusion that falls within the compass of the three figures, as well as the mean of proof, is comprehended. The rules of all the figures might be easily deduced from it; and it appears that there is only one principle of reasoning in all the three; so that it is not strange, that a syllogism of one figure should be reduced to one of another figure.

"The general principle in which the whole terminates, and of which every categorical syllogism is only a particular application, is this, That what is affirmed or denied of the whole genus may be affirmed or denied of every species and individual belonging to it. This is a principle of undoubted certainty indeed, but of no great depth. Aristotle and all the logicians assume it as an axiom, or first principle, from which the syllogistic system, as it were, takes its departure; and after a tedious voyage, and great expense of demonstration, it lands at last in this principle, as its ultimate conclusion. *O curas hominum! O quantum est in rebus inane!*"*

When we compare this mockery of science with the unrivalled powers of the inventor, it is scarcely possible to avoid suspecting, that he was anxious to conceal its real poverty and nakedness, under the veil of the abstract language in which it was exhibited. It is observed by the author last quoted, that Aristotle hardly ever gives examples of real syllogisms to illustrate his rules; and that his commentators, by endeavouring to supply this defect, have only brought into contempt the theory of their master. "We acknowledge, (says he) that this was charitably done, in order to assist the conception in matters so very abstract: but whether it was prudently done for the honour of the art, may be doubted." One thing is certain, that when we translate any of Aristotle's demonstrations from the general and enigmatical language in which he states it, into more familiar and intelligible terms, by applying it to a particular example, the mystery at once disappears, and resolves into some self-evident or identical puerility. It is surely a strange mode of proof, which would establish the truth of what is obvious, and what was never doubted of, by means of an argument which appears quite unintelligible, till explained and illustrated by an instance perfectly similar to the very thing to be proved.

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* This axiom is called, in scholastic language, the *dictum de omni et de nullo*.

"If A (says Aristotle) is attributed to every B, and B to every C, it follows necessarily, that A may be attributed to every C."* Such is the demonstration given of the first mode of the first figure; and it is obviously nothing more than the axiom, called the *dictum de omni*, concealed under the disguise of an uncouth and cabalistical phraseology. The demonstrations given of the other legitimate modes are all of the same description.

In disproving the illegitimate modes, he proceeds after a similar manner; condescending, however, in general, to supply us, by way of example, with three terms, such as *bonum*, *habitus*, *prudentia; album*, *equus*, *cygnus*;—which three terms, we are left, for our own satisfaction, to form into illegitimate syllogisms of the particular figure and mode which may be under consideration. The manifest inconclusiveness of every such syllogism, he seems to have thought, might assist readers of slower apprehension in perceiving more easily the import of the general proposition. The inconclusiveness, for instance, of those modes of the first figure, in which the major is particular, is thus stated and explained. "If A is or is not in some B, and B in every C, no conclusion follows. Take for the terms in the affirmative case, *good*, *habit*, *prudence;* in the negative, *good*, *habit*, *ignorance*."* With respect to such passages as this, Dr. Reid has perfectly expressed my feeling, when he says; "That the laconic style of the author, the use of symbols not familiar, and, in place of giving an example, his leaving us to form one from three assigned terms, give such embarrassment to a reader, that he is like one reading a book of riddles."† Can it be reasonably supposed, that so great an obscurity in such a writer was not the effect of some systematical design?

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* Analyt. Prior. cap. iv.

It is obvious, that Aristotle's symbolical demonstrations might be easily thrown into the form of symbolical syllogisms. The circumstance which induced him to prefer the former mode of statement, was probably that he might avoid the appearance of reasoning in a circle, by employing the syllogistic theory to demonstrate itself. It is curious how it should have escaped him, that, in attempting to shun this fallacy, he had fallen into another exactly of the same description;—that of employing an argument in the common form to demonstrate the legitimacy of syllogisms, after having represented a syllogistic analysis as the only infallible test of the legitimacy of a demonstration.

From the various considerations already stated, I might perhaps, without proceeding farther, be entitled to conclude, that Aristotle's demonstrations amount to nothing more than to a specious and imposing parade of words; but the innumerable testimonies to their validity, from the highest names, and the admiration in which they continue to be held by men of distinguished learning, render it necessary for me, before dismissing the subject, to unfold a little more completely some parts of the foregoing argument.

It may probably appear to some of my readers superfluous to remark, after the above-cited specimens of the reasonings in question, that not one of these demonstrations ever carry the mind forward, a single step, from one truth to another; but merely from a *general axiom* to some of its particular exemplifications. Nor is this all; they carry the mind in a direction *opposite* to that in which its judgments are necessarily formed. The meaning of a general axiom, it is well known, is seldom, if ever intelligible, till it has been illustrated by some example; whereas Aristotle, in all his demonstrations, proceeds on the idea, that the truth of an axiom, in particular instances, is *a logical consequence* of its truth, as enunciated in general terms. Into this mistake, it must be owned, he was not unnaturally led by the place which is assigned to axioms at the beginning of the elements of geometry, and by the manner in which they are afterwards referred to in demonstrating the propositions. Since A (it is said) is equal to B, and B to C, A is equal to C; *for, things which are equal to one and the same thing, are equal to one another.*" This place, I have little doubt, has been occupied by mathematical axioms, as far back, at least, as the foundation of the Pythagorean school; and Aristotle's fundamental axiom will be found to be precisely of the same description. Instead, therefore, of saying, with Dr. Gillies, that, "on the basis of one single truth Aristotle has reared a lofty and various structure of abstract science,"—it would be more correct to say, that the whole of this science is comprised or implied in the terms of one single axiom. Nor must it be forgotten (if we are to retain Dr. Gillies's metaphor) that the structure may, with much more propriety, be considered as the basis of the axiom, than the axiom of the structure.

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* Analyt. Prior. cap. iv.

† Dr. Gillies has attempted a vindication of the use which Aristotle, in his demonstrations, has made of the letters of the alphabet. For some remarks on this attempt, See Note (L.)

When it is recollected, that the greater part of our best philosophers (and among the rest, Dr. Reid) still persevere, after all that Locke has urged on the opposite side of the question, in considering axioms as the ground-work of mathematical science, it will not appear surprising, that Aristotle's demonstrations should have so long continued to maintain their ground in books of logic. That this idea is altogether erroneous, in so far as mathematics is concerned, has been already sufficiently shown; the whole of that science resting ultimately, not on axioms, but on definitions or hypotheses. By those who have examined my reasonings on this last point, and who take the pains to combine them with the foregoing remarks, I trust it will be readily allowed, that the syllogistic theory furnishes no exception to the general doctrine concerning demonstrative evidence, which I formerly endeavoured to establish; its pretended demonstrations being altogether nugatory, and terminating at last (as must be the case with every process of thought involving no *data* but what are purely axiomatical) in the very proposition from which they originally set out.

The idea that all demonstrative science must rest ultimately on axioms, has been borrowed, with many other erroneous maxims, from the logic of Aristotle; but is now, in general, stated in a manner much more consistent (although perhaps not nearer to the truth) than in the works of that philosopher. According to Dr. Reid, the degree of evidence which accompanies our conclusions, is necessarily determined by the degree of evidence which accompanies our first principles; so that, if the latter be only probable, it is perfectly impossible that the former should be certain. Agreeing, therefore, with Aristotle, in considering axioms as the basis of all demonstrative science, he was led, at the same time, in conformity with the doctrine just mentioned, to consider them as eternal and immutable truths, which are perceived to be such by an intuitive judgment of the understanding. This, however, is not the language of Aristotle; for, while he tells us, that there is no demonstration but of eternal truths,* he asserts, that the first principles which are the foundation of all demonstration, are got by induction from the information of sense.† In what manner this apparent contradiction is to be reconciled, I leave to the consideration of his future commentators.

For my own part, I cannot help being of opinion with Lord Monboddo, (who certainly was not wanting in a due respect for the authority of Aristotle) that the syllogistic theory would have accorded much better with the doctrine of Plato concerning *general ideas*, than with that held on the same subject by the founder of the Peripatetic school.‡ To maintain that, in all demonstration, we argue from generals to particulars, and, at the same time, to assert, that the necessary progress of our knowledge is from particulars to generals, by a gradual induction from the informations of sense, do not appear, to an ordinary understanding, to be very congruous parts of the same system;* and yet the last of these tenets has been eagerly claimed as a discovery of Aristotle, by some of the most zealous admirers of his logical demonstrations.†

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* Φανερον δε και, εαν ωσιν αἱ προτασεις καθολου εξ ὧν ὁ συλλογισμος, ὅτι αναγκη και το συμπερασμα αΐδιον ειναι της τοιαυτης αποδειξεως, και της (ἁπλως ειπειν) αποδειξεως. ουκ εστιν αρα αποδειξις των φθαρτων, ουδ᾽ επιστημη ἁπλως, αλλ᾽ ὁυτως, ὥσπερ κατα συμβεβηκος· Analyt. Post. Lib. i. cap. viii.

† Εκ μεν ουν αισθησεως γιγνεται μνημη. εκ δε μνημης πολλακις του αυτου γινομενης, εμπειρια. αἱ γαρ πολλαι μνημαι τῳ αριθμῳ, εμπειρια μια εστιν. εκ δ᾽ εμπειριας η εκ παντος ηρεμησαντος του καθολου εν τῃ ψυχῃ, του ἑνος παρα τα πολλα, ὃ αν εν ἅπασιν ἓν ενῃ εκεινοις το αυτο, τεχνης αρχη και επιστημης· εαν μεν περι γενεσιν, τεχνης· εαν δε περι το ον, επιστημης. (Analyt. Post. Lib. ii. cap. xix.) The whole chapter may be read with advantage by those who wish for a fuller explanation of Aristotle's opinion on this question. His illustration of the intellectual process by which general principles are obtained from the perceptions of sense, and from reiterated acts of memory resolving into *one experience*, is more particularly deserving of attention.

‡ Ancient Metaphysics, Vol. V. pp. 184, 185.

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* It may perhaps be asked, Is not this the very mode of philosophizing recommended by Bacon, first, to proceed analytically from particulars to generals, and then to reason synthetically from generals to particulars? My reply to this question, (a question which will not puzzle any person at all acquainted with the subject) I must delay, till I shall have an opportunity, in the progress of my work, of pointing out the essential difference between the meanings annexed to the word *induction*, in the Aristotelian, and in the Baconian logic.—Upon the present occasion, it is sufficient to observe, that Bacon's plan of investigation was never supposed to be applicable to the discovery of principles which are necessary and eternal.

† See Dr. Gillies's Analysis of Aristotle's works, *passim*.

In this learned, and on the whole very instructive performance, I find several doctrines ascribed to Aristotle, which appear not a little at variance with each other. The following passages (which I am led to select from their connexion with the present argument) strike me as not only widely different, but completely contradictory, in their import.

"According to Aristotle, *definitions* are the foundations of all science; *but those fountains are pure only when they originate in an accurate examination, and patient comparison of the perceptible qualities of individual objects.*" Vol. I. p. 77.

"Demonstrative truth can apply only to those things which *necessarily exist* after a certain manner, and whose state is unalterable: and we know those things when we know their causes: Thus we know a mathematical proposition, when we know the causes that make it true; that is, when we know all the intermediate propositions, up to *the first principles or axioms, on which it is ultimately built.*" Ibid. pp. 95, 96.

It is almost superfluous to observe, that while the former of these quotations founds all demonstrative evidence on *definitions*, the latter founds it upon *axioms*. Nor is this all. The former (as is manifest from the second clause of the sentence) can refer only to *contingent* truths; inasmuch as the most accurate examination of the perceptible qualities of individual objects can never lead to the knowledge of things which *necessarily exist after a certain manner*. The latter as obviously refers (and exclusively refers) to truths which resemble mathematical theorems.

In *this* point of view, Lord Monboddo has certainly conducted, with greater skill, his defence of the syllogistic theory; inasmuch as he has entirely abandoned the important conclusions of Aristotle concerning the natural progress of human knowledge; and has attempted to entrench himself in (what was long considered as one of the most inaccessible fastnesses of the Platonic philosophy) the very ancient theory, which ascribes to *general ideas* an existence necessary and eternal. Had he, upon this occasion, after the example of Aristotle, confined himself solely to abstract principles, it might not have been as easy task to refute, to the satisfaction of common readers, his metaphysical arguments. Fortunately, however, he has favoured us with some examples and illustrations, which render this undertaking quite unnecessary; and which, in my opinion, have given to the cause which he was anxious to support, one of the most deadly blows which it has ever received. The following panegyric, in particular, on the utility of logic, while it serves to show that, in admiration of the Aristotelian demonstrations, he did not yield to Dr. Gillies, forms precisely such a comment as I myself could have wished for, on the leading propositions which I have now been attempting to establish.

As to Aristotle's assertion, that *definitions* are the first principles of all *demonstrations* (αἱ αρχαι των αποδειξεων οἱ ὁρισμοι,) it undoubtedly seems, at first view, to coincide exactly with the doctrine which I was at so much pains to inculcate, in treating of that peculiar evidence which belongs to mathematics. I hope, however, I shall not, on this account, be accused of plagiarism, when it is considered, that the commentary upon these words, quoted above from Dr. Gillies, absolutely *excludes* mathematics from the number of those sciences to which they are to be applied.—On this point, "In proof of the utility of logic,* (says Lord Monboddo) I will give an example of an argument to prove that man is a substance; which argument, put into the syllogistic form, is this:

"Every Animal is a Substance;
Every Man is an Animal;
Therefore every Man is a Substance."

"There is no man, I believe, who is not convinced of the truth of the conclusion of this syllogism: But, how he is convinced of this, and for what reason he believes it to be true, no man can tell, who has not learned, from the logic of Aristotle, to know what a proposition, and what a syllogism is. There he will learn, that every proposition affirms or denies something of some other thing. What is affirmed or denied is called the Predicate; and that of which it is affirmed or denied, is called the Subject. The predicate being a more general idea than the subject of which it is predicated, must contain or include it, if it be an affirmative proposition; or if it be a negative proposition, it must exclude it. This is the nature of propositions: And as to syllogism, the use of it is to prove any proposition that is not self-evident. And this is done by finding out what is called a *middle term;* that is, a term connected with both the predicate and the subject of the proposition to be proved. Now the proposition to be proved here is, that *man is a substance;* or, in other words, that *substance* can be predicated of *man:* And the middle

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too, Aristotle's own language is decisive. Εξ αναγκαιων αρα συλλογισμος εστιν ἡ αποδειξις. Analyt. Poster. Lib. i. Cap. iv.

* Ancient Metaphysics, Vol. V. p. 152.

term, by which this connexion is discovered, is *animal*, of which substance is predicated; and this is the major proposition of the syllogism, by which the major term of the proposition to be proved, is predicated of the middle term. Then *animal* is predicated of *man;* and this is the minor proposition of the syllogism, by which the middle term is predicated of the lesser term, or subject of the proposition to be proved. The conclusion, therefore, is, that as substance contains animal, and man is contained in animal, or is part of animal, therefore *substance* contains *man*. And the conclusion is necessarily deduced from the axiom I have mentioned, as the foundation of the truth of the syllogism, 'That the whole is greater than any of its parts, and contains them all.' So that the truth of the syllogism is as evident as when we say, that if A contain B, and B contain C, then A contains C.

"In this manner Aristotle has demonstrated the truth of the syllogism. But a man, who has not studied his logic, can no more tell why he believes the truth of the syllogism above mentioned, concerning *man being a substance*, than a joiner, or any common mechanic, who applies a foot or a yard to the length of two bodies, and finds that both agree exactly to that measure, and are neither longer nor shorter, can give a reason why he believes the bodies to be equal, not knowing the axiom of Euclid, 'That two things, which are equal to a third thing, are equal to one another.'

"By this discovery Aristotle has answered the question which Pontius Pilate, the Roman Governor, asked of our Saviour, *What Truth is?* The answer to which appears now to be so obvious, that I am persuaded Pilate would not have asked it as a question, which he no doubt thought very difficult to be answered, if he had not studied the logic of Aristotle."*

After perusing the above exposition of Aristotle's demonstration, the reader, if the subject be altogether new to him, will be apt to imagine, that the study of logic is an undertaking of much less difficulty than he had been accustomed formerly to apprehend; the whole resolving ultimately into this axiom, "That if A contains B, and B contains C, then A contains C." In interpreting this axiom, he will probably figure to himself A, B, and C, as bearing some resemblance to three boxes, the sizes of which are so adapted to each other, that B may be literally put into the inside of A, and C into the inside of B. Perhaps it may be reasonably doubted, if there is one logician in a hundred, who ever dreamed of understanding it in any other sense. When considered in this light, it is not surprising that it should instantly command the assent of the merest novice: nor would he hesitate one moment longer about its truth, if, instead of being limited (in conformity to the three terms of a syllogism) to the three letters, A, B, C, it were to be extended from A to Z; *the series of boxes* corresponding to the *series of letters*, being all conceived to be *nestled*, one within another, like those which we sometimes see exhibited in the hands of a juggler.

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* Ancient Metaphysics, Vol. V. pp. 152, 153, 154.

I have quoted this passage at length, because I consider it as an instructive example of the effects likely to be produced on the understanding by scholastic studies, where they become a favourite and habitual object of pursuit. The author (whom I knew well, and for whose memory I entertain a sincere respect) was a man of no common mental powers. Besides possessing a rich fund of what is commonly called learning, he was distinguished by natural acuteness; by a more than ordinary share of wit; and, in the discharge of his judicial functions, by the singular correctness, gravity, and dignity of his unpremeditated elocution;—and yet, so completely had his faculties been subdued by the vain abstractions and verbal distinctions of the schools, that he had brought himself seriously to regard such discussions as that which I have here transcribed from his works, not only as containing much excellent sense, but as the quintessence of sound philosophy. As for the mathematical and physical discoveries of the Newtonians, he held them in comparative contempt, and was probably prevented, by this circumstance, from ever proceeding farther than the first elements of these sciences. Indeed, his ignorance of both was wonderful, considering the very liberal education which he had received, not only in his own country, but at a foreign university.

If the curiosity of the student, however, should lead him to inquire a little more accurately into Aristotle's meaning, he will soon have the mortification to learn, that when one thing is said by the logician, *to be in another*, or *to be contained in another*, these words are not to be understood in their ordinary and most obvious sense, but in a particular and technical sense, known only to adepts; and about which (we may remark by the way) adepts are not, to this day, unanimously agreed. "To those (says Lord Monboddo) who know no more of logic nor of ancient philosophy than Mr. Locke did, it will be necessary to explain in what sense one idea can be said to contain another, or the idea less general can be said to be a part of the more general. And, in the first place, it is not in the sense that one body is said to be a part of another, or the greater body to contain the lesser; nor is it as one number is said to contain another; but it is *virtually or potentially* that the more general idea contains the less general. In this way the genus contains the species; for the genus may be predicated of every species under it, whether existing or not existing; so that *virtually* it contains all the specieses under it, which exist or may exist. And not only does the more general contain the less general, but (what at first sight may appear surprising) the less general contains the more general, not *virtually* or *potentially*, but *actually*. Thus, the genus animal contains *virtually* man, and every other species of animal either existing or that may exist: But the genus animal is contained in man, and in other animals *actually*: for man cannot exist without being in *actuality*, and not *potentially* only, an animal."*

If we have recourse to Dr. Gillies for a little more light upon this question, we shall meet with a similar disappointment. According to him, the meaning of the phrases in question is to be sought for in the following definition of Aristotle: "To say that one thing is contained in another, is the same as saying, that the second can be predicated of the first in the full extent of its signification; and one term is predicated of another in the full extent of its signification, when there is no particular denoted by the subject, to which the predicate does not apply."†

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* Ancient Metaphysics, Vol. IV. p. 73.

For the distinction betwixt containing *potentially* and *actually*, Lord Monboddo acknowledges himself indebted to a Greek author then living, Eugenius Diaconus. (*Anc. Met.* Vol. IV. p. 73.) Of this author we are elsewhere told, that he was a professor in the Patriarch's University at Constantinople; and that he published, in pure Attic Greek, a system of logic, at Leipsic, in the year 1766. (*Origin and Progress of Language*, Vol. I. p. 45, 2d edit.) It is an extraordinary circumstance, that a discovery, on which, in Lord Monboddo's opinion, *the whole truth of the syllogism depends*, should have been of so very recent a date.

† Gillies's Aristotle, Vol. I. p. 73. "This remark (says Dr. Gillies) *which is the foundation of all Aristotle's logic*, has been sadly mistaken by many. Among others, Dr. Reid accuses Aristotle of using as synonymous phrases,

In order, therefore, to make sure of Aristotle's idea, we must substitute the definition instead of the thing defined; that is, instead of saying that one thing is contained in another, we must say, that "that the second can be predicated of the first in the full extent of its signification." In this last clause, I give Aristotle all the advantage of Dr. Gillies's very paraphrastical version; and yet, such is the effect of the comment, that it at once converts our axiom into a riddle. I do not say that, when thus interpreted, it is altogether unintelligible; but only that it no longer possesses the same sort of evidence which we ascribed to it, while we supposed that one thing was said by the logician to be *contained* in another, in the same sense in which a smaller box is *contained* in a greater.*

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the being in a subject, and the being truly predicated of a subject; whereas the truth is, that, according to Aristotle, the meaning of the one phrase is directly the reverse of the meaning of the other." Ibid.

While I readily admit the justness of this criticism on Dr. Reid, I must take the liberty of adding, that I consider Reid's error as a mere oversight, or slip of the pen. That he might have accused Aristotle of confounding two things which, although different in fact, had yet a certain degree of resemblance or affinity, is by no means impossible: but it is scarcely conceivable, that he could be so careless as to accuse him of confounding two things which he invariably states in direct opposition to each other. I have not a doubt, therefore, that Reid's idea was, that Aristotle used, as synonymous phrases, the being in a thing, and the being a subject of which that thing can be truly predicated; more especially, as either statement would equally well have answered his purpose.

* It is worthy of observation, that Condillac has availed himself of the same metaphorical and equivocal word which the foregoing comments profess to explain, in support of the theory which represents every process of sound reasoning as a series of identical propositions. "L'Analyse est la même dans toutes les sciences, parce que dans toutes elle conduit du connu à l'inconnu par le raisonnement c'est-à-dire, par une suite de jugemens qui sont *refermés* les uns dans les autres." *La Logique*

To both comments the same observation may be applied; that, the moment a person reads them, he must feel himself disposed to retract his assent to the axiom which they are brought to elucidate; inasmuch as they must convince him, that what appeared to be, according to the common signification of words, little better than a *truism*, becomes, when translated into the jargon of the schools, an incomprehensible, if not, at bottom, an unmeaning *ænigma*.

I have been induced to enlarge, with more minuteness than I could have wished on this fundamental article of logic, that I might not be accused of repeating those common-place *generalities* which have, of late, been so much complained of by Aristotle's champions. I must not, however, enter any farther into the details of the system; and shall therefore proceed, in the next section, to offer a few remarks of a more practical nature, on the object and on the value of the syllogistic art.

SECTION II.

General Reflections on the Aim of the Aristotelian Logic, and on the Intellectual Habits which the study of it has a tendency to form.—That the improvement of the power of reasoning ought to be regarded as only a secondary Object in the culture of the Understanding.

THE remarks which were long ago made by Lord Bacon on the inutility of the *syllogism* as an organ of scientific discovery, together with the acute strictures in Mr. Locke's Essay on this form of reasoning, are so decisive in point of argument, and, at the same time, so familiarly known to all who turn their attention to philosophical inquiries, as to render it perfectly unnecessary for me, on the present occasion, to add any thing in support of them. I shall, therefore, in the sequel, confine myself to a few very general and miscellaneous reflections on one or two points overlooked by these eminent writers; but to which it is of essential importance to attend, in order to estimate justly the value of the Aristotelian logic, considered as a branch of education.*

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* To some of my readers it may not be superfluous to recommend, as a valuable supplement to the discussions of Locke and Bacon concerning the syllogistic art, what has been since written on the same subject, in farther prosecution of their views, by Dr. Reid, in his Analysis of Aristotle's Logic, and by Dr. Campbell in his Philosophy of Rhetoric.

It is an observation which has been often repeated since Bacon's time, and which, it is astonishing, was so long in forcing itself on the notice of philosophers, That, in all our reasonings about the established order of the universe, experience is our sole guide, and knowledge is to be acquired only by ascending from particulars to generals; whereas the syllogism leads us invariably from universals to particulars, the truth of which, instead of being a *consequence* of the universal proposition, is *implied* and *presupposed* in the very terms of its enunciation. The syllogistic art, therefore, it has been justly concluded, can be of no use in extending our knowledge of nature.*

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* On this point it would be a mere waste of time to enlarge, as it has been of late explicitly admitted by some of the ablest advocates for the *Organon* of Aristotle. "When Mr. Locke, (I quote the words of a very judicious and acute logician) when Mr. Locke says—"I am apt to think, that he who should employ all the force of his reason only in brandishing of syllogisms, will discover very little of that mass of knowledge, which lies yet concealed in the secret recesses of nature"—he expresses himself with needless caution. Such a man will certainly not discover any of it. And if any imagined, that the mere *brandishing of syllogisms* could increase their knowledge, (as some of the schoolmen seemed to think) they were indeed very absurd." (*Commentary on the Compendium of Logic* used in the University of Dublin. By the Rev. John Walker. Dublin, 1805.)

To the same effect, it is remarked, by a later writer, with respect to Lord Bacon's assertion, "that *discoveries* in Natural Philosophy are not likely to be promoted by the engine of syllogism;"—"that this is a proposition which no one of the present day disputes; and which, when alleged by our adversaries, as their chief objection to the study of logic, only proves, that they are ignorant of the subject about which they are speaking, and of the manner in which it is *now* taught." (*See an Anonymous Pamphlet printed at Oxford in* 1810, p. 26.) Dr. Gillies has expressed himself in terms extremely similar upon various occasions. (See, in particular, Vol. I. pp. 63, 64, 2d edit.)

This very important concession reduces the question about the utility of the Aristotelian logic within a very narrow compass.

To this observation it may be added, That, if there are any parts of science in which the syllogism can be advantageously applied, it must be those where our judgments are formed, in consequence of an application to particular cases of certain maxims which we are not at liberty to dispute. An example of this occurs in the practice of Law. Here, the particular conclusion must be regulated by the general principle, whether right or wrong. The case was similar in every branch of philosophy, as long as the authority of great names prevailed, and the old scholastic maxims were allowed, without examination, to pass as incontrovertible truths.* Since the importance of experiment and observation was fully understood, the syllogistic art has gradually fallen into contempt.

A remark somewhat similar occurs in the preface to the *Novum Organon.* "They who attributed so much to logic (says Lord Bacon) perceived very well and truly, that it was not safe to trust the understanding to itself, without the guard of any rules. But the remedy reached not the evil, but became a part of it; *For the logic which took place, though it might do well enough in civil affairs, and the arts which consisted in talk and opinion,* yet comes very far short of subtilty, in the real performances of nature; and, catching at what it cannot reach, has served to confirm and establish errors, rather than open a way to truth."*

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* "Ce sera un sujet éternel d'étonnement pour les personnes qui savent bien ce que c'est que philosophie, que de voir que l'autorité d'Aristote a été tellement respectée dans les ecoles pendant quelques siècles, que lors qu'un disputant citoit un passage de ce philosophe, celui qui soutenoit la these n'osoit point dire *transeat;* il falloit qu'il niât le passage, ou qu'il l'expliquât à sa manière." Dict. de Bayle. Art. *Aristote.*

It is not, however, merely as a useless or inefficient organ for the discovery of truth, that this art is exceptionable. The importance of the very object at which it professedly aims is not a little doubtful. To exercise with correctness the powers of deduction and of argumentation; or, in other words, to make a legitimate inference from the premises before us, would seem to be an intellectual process which requires but little assistance from rule. The strongest evidence of this is, the facility with which men of the most moderate capacity learn, in the course of a few months, to comprehend the longest mathematical demonstrations; a facility which, when contrasted with the difficulty of enlightening their minds on questions of morals or of politics, affords a sufficient proof, that it is not from any inability to conduct a mere logical process, that our speculative errors arise. The fact is, that, in most of the sciences, our reasonings consist of a very few steps; and yet, how liable are the most cautious and the most sagacious, to form erroneous conclusions!

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* As the above translation is by Mr. Locke, who has introduced it in the way of apology for the freedom of his own strictures on the school logic, the opinion which it expresses may be considered as also sanctioned by the authority of *his* name. (*See the Introduction to his Treatise on the Conduct of the Understanding.*) I cannot forbear remarking, on this occasion, that when Lord Bacon speaks of the school logic as "answering well enough in civil affairs, and the arts which consist in talk and opinion," his words can only apply to *dialectical* syllogisms, and cannot possibly be extended to those which Aristotle calls *demonstrative*. Whatever praise, therefore, it may be supposed to imply, must be confined to the Books of *Topics*. The same observation will be found to hold with respect to the greater part of what has been alleged in defence of the syllogistic art, by Dr. Gillies, and by the other authors referred to in the beginning of this section. One of the ablest these seems to assent to an assertion of Bacon, "That logic does not help towards the invention of arts and sciences, but only "of arguments." If it only helps towards the invention of arguments, for what purpose has Aristotle treated so fully of demonstration and of science in the two books of the Last Analytics.)

To enumerate and examine the causes of these false judgments is foreign to my purpose in this section. The following (which I mention only by way of specimen) seem to be among the most powerful. 1. The imperfections of language, both as an instrument of thought, and as a medium of philosophical communication. 2. The difficulty, in many of our most important inquiries, of ascertaining the *facts* on which our reasonings are to proceed. 3. The partial and narrow views, which, from want of information, or from some defect in our intellectual comprehension, we are apt to take of subjects, which are peculiarly complicated in their details, or which are connected, by numerous relations, with other questions equally problematical. And lastly, (what is of all, perhaps, the most copious source of speculative error) the prejudices which authority and fashion, fortified by early impressions and associations, create to warp our opinions. To illustrate these and other circumstances by which the judgment is apt to be misled in the search of truth, and to point out the most effectual means of guarding against them, would form a very important article in a philosophical system of logic; but it is not on such subjects that we are to expect information from the logic of Aristotle.*

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* In the Logic of *Port-Royal*, there is a chapter, entitled, *Des sophismes d'amour propre, d'interêt, et de passion*, which is well worthy of a careful perusal. Some useful hints may be also collected from Gravesande's *Introductio ad Philosophiam.* See Book ii. Part ii. (*De Causis Errorum.*)

The fundamental idea on which this philosopher evidently proceeded, and in which he has been too implicitly followed by many even of those who have rejected his syllogistic theory, takes for granted, that the discovery of truth chiefly depends on the reasoning faculty, and that it is the comparative strength of this faculty, which constitutes the intellectual superiority of one man above another. The similiarity between the word *reason* and *reasoning*, of which I formerly took notice, and the confusion which it has occasioned in their appropriate meanings, has contributed powerfully to encourage and to perpetuate this unfortunate mistake. If I do not greatly deceive myself, it will be found, on an accurate examination of the subject, that, of the different elements which enter into the composition of *reason*, in the most enlarged acceptation of that word, the power of carrying on long processes of *reasoning* or *deduction*, is, in point of importance, one of the least."*

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* It was before observed, (p. 136.) "That the whole theory of syllogism proceeds on the supposition, that the same word is always to be employed in the same sense; and that, consequently, it takes for granted, in every rule which it furnishes for the guidance of our reasoning powers, that the nicest, and by far the most difficult part of the logical process, has been previously brought to a successful termination."

In this remark (which, obvious as it may seem, has been very generally overlooked) I have found, since the foregoing sheets were printed, that I have been anticipated by M. Turgot. "Tout l'artifice de ce calcul ingénieux, dont Aristote nous a donné les règles, tout l'art du syllogisme est fondé sur l'usage des mots dans le même sens; l'emploi d'un même mot dans deux sens différens fait de tout raisonnement un sophisme; et ce genre de sophisme, peut-être le plus commun de tous, est une des sources les plus ordinaires de nos erreurs." *Oeuvres de M. Turgot*, Tom. III. p. 66.

Lord Bacon had manifestly the same conclusion in view, in the following aphorism: "Syllogism consists of propositions, propositions of words, and words are the signs of notions; therefore if our notions, the basis of all, The slightest reflection, indeed, may convince us, how very little connexion the mere reasoning faculty has with the general improvement of mankind. The wonders which it has achieved having been confined, in a great measure, to the mathematical sciences,—the only branches of human knowledge which furnish occasion for long concatenated processes of thought; and even there, *method*, together with a dexterous use of the helps to our intellectual faculties which art has discovered, will avail more than the strongest conceivable capacity, exercised solely and exclusively in habits of synthetic deduction. The tendency of these helps, it may be worth while to add, is so far from being always favourable to the power of reasoning, strictly so called, that it may be questioned, whether, among the ancient Greek geometers, this power was not in a higher state of cultivation, in consequence of their ignorance of the algebraical symbols, than it exists in at this day, among the profoundest mathematicians of Europe.

In the other sciences, however, the truth of the remark is far more striking. By whom was ever the art of reasoning so sedulously cultivated as by the schoolmen, and where shall we find such monuments of what *mere reasoning* can accomplish, as in their writings? Whether the same end might not have been attained without the use of

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are confined, and over hastily taken from things, nothing that is built on them can be firm; whence our only hope rests upon *genuine* induction." *Nov. Org.* Part. I. Sect. 1. Aph. 14. (Shaw's Translation.)

On what grounds Dr. Gillies was led to hazard the assertion formerly quoted (p. 241) that "Aristotle invented the syllogism to prevent imposition arising from the abuse of "words," I am quite unable to form a conjecture.

their technical rules, is a different question; but that they *did* succeed to a great degree, in the acquisition of the accomplishments at which they aimed, cannot be disputed. And yet, I believe, it will be now very generally admitted, that never were labour and ingenuity employed, for so many ages, to so little purpose of real utility. The absurdity of expecting to rear a fabric of science by the art of reasoning alone, was remarked, with singular sagacity, even amidst the darkness of the 12th century, by *John of Salisbury*, himself a distinguished proficient in scholastic, learning, which he had studied under the celebrated *Abelard*. "After a long absence from *Paris*, (he tells us in one passage) I went to visit the companions of my early studies. I found them, in every respect, precisely as I had left them; not a single step advanced towards a solution of their old difficulties, nor enriched by the accession of one new idea:—a strong experimental proof, that, how much soever logic may contribute to the progress of other sciences, it must for ever remain barren and lifeless, while abandoned to itself."*

Among the various pursuits now followed by men liberally educated, there is none, certainly, which affords such scope to the reasoning faculty, as the science and profession of law; and accordingly, it has been observed by Mr. Burke, "That they do more to *quicken and invigorate the understanding*, than all the other kinds of learning put together." The same author however adds, that "they are not apt, except in persons very happily born, to open and to liberalize the mind, exactly in the same proportion." Nor is this surprising; for the ultimate standards of right and wrong to which they recognize the competency of an appeal, being conventional rules and human authorities, no field is opened to that spirit of free inquiry which it is the boast of philosophy to cultivate. The habits of thought, besides, which the long exercise of the profession has a tendency to form, on its appropriate topics, seem unfavourable to the qualities connected with what is properly called *judgment;* or, in other words, to the qualities on which the justness or correctness of our *opinions* depends; they accustom the mind to those partial views of things which are suggested by the separate interests of litigants; *not* to a calm, comprehensive, and discriminating survey of details, in all their bearings and relations. Hence the apparent inconsistencies which sometimes astonish us in the intellectual character of the most distinguished practitioners,—a talent for acute and refined distinctions; powers of subtle, ingenious, and close argumentation; inexhaustible resources of invention, of wit, and of eloquence;—combined, not only with an infantine imbecility in the affairs of life, but with an incapacity of forming a sound decision, even on those problematical questions which are the subjects of their daily discussion. The great and enlightened *minds,* whose judgments have been transmitted to posterity, as oracles of legal wisdom, were formed (it may be safely presumed) not by the habits of their professional warfare, but by contending with these habits, and shaking off their dominion.

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* Metalog. Lib. ii. cap. 10.

The habits of a controversial writer are, in some respects, analogous to those of a lawyer; and their effects on the intellectual powers, when engaged in the investigation of truth, are extremely similar. They confine the attention to one particular view of the question, and, instead of training the understanding to combine together the various circumstances which seem to favour opposite conclusions, so as to limit each other, and to guard the judgment against either extreme,—they are apt, by presenting the subjects sometimes wholly on the one side, and sometimes wholly on the other, to render the disputant the sceptical dupe of his own ingenuity. Such seems to have been nearly the case with the redoubtable Chillingworth; a person to whose native candour the most honourable testimony has been borne by the most eminent of his contemporaries, and whose argumentative powers have almost become matter of proverbial remark. Dr. Reid has pronounced him the "best reasoner, as well as the acutest logician of his age;" and Locke himself has said, "If you would have your son to reason well, let him read Chillingworth." To what consequences these rare endowments and attainments led, we may learn from Lord Clarendon.

"Mr. Chillingworth had spent all his younger time in disputations, and had arrived at so great a mastery, that he was inferior to no man in those skirmishes: but he had, with his notable perfection in this exercise, contracted such an irresolution and habit of doubting, that by degrees he grew confident of nothing."—"Neither the books of his adversaries, nor any of their persons, though he was acquainted with the best of both, had ever made great impression on him; all his doubts grew out of himself, when he assisted his scruples with all the strength of his own reason, and was then too hard for himself: but finding as little quiet and repose in those victories, he quickly recovered, by a new appeal to his own judgment; so that, in truth, he was in all his sallies and retreats, his own convert."

The foregoing observations, if well founded, conclude strongly, not merely against the *form* of the school logic, but against the importance of the *end* to which it is directed. Locke and many others have already sufficiently shown, how inadequate the syllogistic theory is to its avowed purpose; but few seem to be sufficiently aware, how very little this purpose, if it were attained, would advance us in the knowledge of those truths which are the most interesting to human happiness.

"There is one species of madman" (says Father Buffier) "that makes an excellent logician."*—The remark has the appearance of being somewhat paradoxical; but it is not without a solid foundation, both in fact, and in the theory of the human understanding. Nor does it apply merely (as Buffier seems to have meant it) to the scholastic defenders of metaphysical paradoxes: it extends to all whose ruling passion is a display of argumentative dexterity, without much solicitude about the justness of their premises, or the truth of their conclusions. It is observed by Lord Erskine, in one of his admirable pleadings lately published, that "in all the cases which have filled Westminster-Hall with the most complicated considerations—the lunatics, and other insane persons, who have been the subjects of them, have not only had the most perfect knowledge and recollection of all the relations they stood in towards others, and of the acts and circumstances of their lives, but *have, in general, been remarkable for subtlety and acuteness*."—"These," (he adds) "are the cases which frequently mock the wisdom of the wisest in judicial trials; because *such persons often reason with a subtlety which puts in the shade the ordinary conceptions of mankind:* their conclusions are just, and frequently profound; but the premises from which they reason, *when within the range of the malady*, are uniformly false:—not false from any defect of knowledge or judgment; but because a delusive image, the inseparable companion of real insanity, is thrust upon the subjugated understanding, incapable of resistance, because unconscious of attack."

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* Traité des Prem. Verités. Part I. chap. xi.

In the instances here alluded to, something, it is probable, ought to be attributed to the physical influence of the disorder in occasioning, together with an increased propensity to controversy, a preternatural and morbid excitation of the power of attention, and of some other intellectual faculties; but much more, in my opinion, to its effects in removing the check of those collateral circumstances by which, in more sober understandings, the reasoning powers are perpetually retarded and controlled in their operation. Among these circumstances, it is sufficient to specify, for the sake of illustration, 1. That distrust, which experience gradually teaches, of the accuracy and precision of the phraseology in which our reasonings are expressed;—accompanied with a corresponding apprehension of involuntary mistakes from the ambiguity and vagueness of language; 2. A latent suspicion, that we may not be fully in possession of all the elements on which the solution of the problem depends; and, 3. The habitual influence of those first principles of propriety, of morality, and of common sense, which, as long as reason maintains her ascendant, exercise a paramount authority over all those speculative conclusions which have any connexion with the business of life. Of these checks or restraints on our reasoning processes, none are cultivated and strengthened, either by the rules of the logician, or by the habits of *viva voce* disputation. On the contrary, in proportion as their regulating power is confirmed, that hesitation and suspense of judgment are encouraged, which are so congenial to the spirit of true philosophy, but such fatal incumbrances in contending with an antagonist whose object is not truth but victory. In madness, where their control is entirely thrown off, the merely logical process (which never stops to analyse the meaning of words) is likely to go on more rapidly and fearlessly than before;—producing a volubility of speech, and an apparent quickness of conception, which present to common observers all the characteristics of intellectual superiority. It is scarcely necessary to add, that the same appearances, which, in this extreme case of mental aberration, are displayed on so great a scale, may be expected to show themselves, more or less, wherever there is any deficiency in those qualities which constitute depth and sagacity of judgment.

For my own part, so little value does my individual experience lead me to place on argumentative address, when compared with some other endowments subservient to our intellectual improvement, that I have long been accustomed to consider that promptness of reply and dogmatism of decision which mark the eager and practised disputant, as almost infallible symptoms of a limited capacity; a capacity deficient (in what Locke has called) in very significant, though somewhat homely terms) *large, sound, roundabout sense.* * In all the higher endowments of the understanding, this intellectual quality (to which nature as well as education must liberally contribute,) may be justly regarded as an essential ingredient. It is this which, when cultivated by study, and directed to great objects or pursuits, produces an unprejudiced, comprehensive, and efficient mind; and where it is wanting, though we may occasionally find a more than ordinary share of quickness and of information; a plausibility and brilliancy of discourse; and that passive susceptibility of polish from the commerce of the world, which is so often united with imposing but secondary talents,—we may rest assured, that there exists a total incompetency for enlarged views and sagacious combinations, either in the researches of science or in the conduct of affairs.†

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* Conduct of the Understanding, § 3.

† The outlines of an intellectual character, approaching nearly to this description, is exhibited by Marmontel in his highly finished (and I have been assured, very faithful) portrait of M. de Brienne. Among the other defects of that unfortunate statesman, he mentions particularly *un esprit à facettes;* by which expression he seems, from the context, to mean a quality of mind precisely opposite to that described by Locke in the words quoted above:—*quelques lumières, mais éparses; des apperçus plutôt que des vues; et dans les grands objets, de la facilité à saisir les petits détails, nulle capacité pour embrasser l'ensemble.*" A consciousness of some similar deficiency has suggested to Gibbon the following criticism on his own juvenile performance, entitled *Essai sur l'Etude.* It is executed by an impartial and a masterly hand; and may perhaps, without much injustice, be extended not only to his Roman history, but to the distinguishing features of that peculiar *cast* of genius, which so strongly marks all his writings.

"The most serious defect of my essay is a kind of obscurity and abruptness which always fatigues, and may often elude the attention of the reader. The obscurity of many passages is often affected; proceeding from the desire of expressing perhaps a common idea with sententious brevity: *brevis esse laboro, obscurus fio.* Alas! how fatal has been the imitation of

If these observations hold with respect to the art of reasoning or argumentation, as it is cultivated by men undisciplined in the contentions of the schools, they will be found to apply with infinitely greater force to those disputants (if any such are still to be found) who, in the present advanced state of human knowledge, have been at pains to fortify themselves, by a course of persevering study, with the arms of the Aristotelian logic. Persons of the former description often reason conscientiously with warmth from false premises which they are led by passion, or by want of information, to mistake for truth. Those of the latter description proceed systematically on the radical error of conceiving the *reasoning process* to be the most powerful instrument by which truth is to be attained; combined with the secondary error of supposing that the power of reasoning may be strengthened and improved by the syllogistic art.

In one of Lord Kames's sketches, there is an amusing and instructive collection of facts to illustrate the *progress of reason;* a phrase by which he seems to mean chiefly the progress of *good sense*, or of that quality of the intellect which is very significantly expressed by the epithet *enlightened*. To what is this progress (which has been going on with such unexampled rapidity during the two last centuries) to be ascribed? Not surely to any improvement in the art of reasoning; for many of the most melancholy weaknesses which he has recorded, were exhibited by men, distinguished by powers of discussion,

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Montesquieu! *But this obscurity sometimes proceeds from a mixture of light and darkness in the author's mind; from a partial ray which strikes upon an angle, instead of spreading itself over the surface of an object.*"

and a reach of thought, which have never been surpassed; while, on the other hand, the same weaknesses would now be treated with contempt by the lowest of the vulgar. The principal cause, I apprehend, has been the general diffusion of knowledge (and more especially of experimental knowledge) by the art of printing: in consequence of which, those prejudices which had so long withstood the assaults both of argument and of ridicule, have been gradually destroyed by their mutual collision, or lost in the infinite multiplicity of elementary truths which are identified with the operations of the infant understanding. To examine the process by which truth has been slowly and insensibly cleared from that admixture of error, with which, during the long night of Gothic ignorance, it was contaminated and disfigured, would form a very interesting subject of philosophical speculation. At present, it is sufficient to remark, how little we are indebted for our emancipation from this intellectual bondage, to those qualities which it was the professed object of the school logic to cultivate; and that, in the same proportion in which liberality and light have spread over Europe, this branch of study has sunk in the general estimation.

Of the inefficacy of *mere reasoning* in bringing men to an agreement on those questions which, in all ages, have furnished to the learned the chief matter of controversy, a very just idea seems to have been formed by the ingenious author of the following lines: who has, at the same time, hinted at a remedy against a numerous and important class of speculative errors, more likely to succeed than any which is to be derived from the most skilful application of Aristotle's rules; or indeed, from any direct argumentative refutation, how conclusive and satisfactory so ever it may appear to an unbiassed judgment. It must, at the same time, be owned, that this remedy is not without danger; and that the same habits which are so useful in correcting the prejudices of the monastic bigot, and so instructive to all whose principles are sufficiently fortified by reflection, can scarcely fail to produce pernicious effects, where they operate upon a character not previously formed and confirmed by a judicious education.

En parcourant au loin la planète ou nous sommes,
Que verrons nous? les torts et les travers des hommes!
Ici c'est un synode, et là c'est un divan,
Nous verrons le Mufti, le Derviche, l'Iman,
Le Bonze, le Lama, le Talapoin, le Pope,
Les antiques Rabbins et les Abbés d'Europe,
Nos moines, nos prélats, nos docteurs agregés;
Etes vous disputeurs, mes amis? voyagez.*

To these verses it may not be altogether useless to subjoin a short quotation from Mr. Locke; in whose opinion the aid of *foreign travel* seems to be less necessary for enlightening *some* of the classes of controversialists included in the foregoing enumeration, than was suspected by the poet. The moral of the passage, (if due allowances be made for the satirical spirit which it breathes) is pleasing on the whole, as it suggests the probability, that our common estimates of the intellectual darkness of our own times are not a little exaggerated.

" Notwithstanding the great noise that is made in the world about errors and opinions, I must do mankind that right as to say, *There are not so many men in errors and wrong opinions, as is commonly supposed.* Not that I think they embrace the truth; but indeed, because concerning those doctrines they keep such a stir about, they have no thought, no opinion at all. For if any one should a little catechize the greatest part of the partizans of most of the sects in the world, he would not find, concerning those matters they are so zealous for, that they have any opinion of their own; much less would he have reason to think that they took them upon the examination of arguments and appearance of probability. They are resolved to stick to a party that education or interest has engaged them in; and there, like the common soldiers of an army, show their courage and warmth as their leaders direct, without ever examining, or so much as knowing the cause they contend for. If a man's life shows that he has no serious regard for religion, for what reason should we think that he beats his head about the opinions of his church, and troubles himself to examine the grounds of this or that doctrine? 'Tis enough for him to obey his leaders, to have his hand and his tongue ready for the support of the common cause, and thereby approve himself to those who can give him credit, preferment, and protection in that society. Thus men become combatants for those opinions they were never convinced of; no, nor ever had so much as floating in their heads; and THOUGH ONE CANNOT SAY THERE ARE FEWER IMPROBABLE OR ERRONEOUS OPINIONS IN THE WORLD THAN THERE ARE, YET THIS IS CERTAIN, THERE ARE FEWER THAT ACTUALLY ASSENT TO THEM, AND MISTAKE THEM FOR TRUTHS, THAN IS IMAGINED."*

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* Discours sur les Disputes, par M. de Rulhiere.

If these remarks of Locke were duly weighed, they would have a tendency to abridge the number of controversial writers; and to encourage philosophers to attempt the improvement of mankind, rather by adding to the stock of useful knowledge, than by waging a direct war with prejudices, which have less root in the understandings than in the interests and passions of their abettors.

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* Essay on Human Understanding. Book iv. c. 20.

SECTION III.

In what respects the study of the Aristotelian Logic may be useful to Disputants.—A general acquaintance with it justly regarded as an essential accomplishment to those who are liberally educated.—Doubts suggested by some late Writers, concerning Aristotle's claims to the invention of the Syllogistic Theory.

THE general result of the foregoing reflections is, That neither the means employed by the school logic for the assistance of the *discursive faculty*, nor the accomplishment of that end, were it really attained, are of much consequence in promoting the enlargement of the mind, or in guarding it against the influence of erroneous opinions. It is, however, a very different question, how far this art may be of use to such as are led by profession or inclination to try their strength in polemical warfare. My own opinion is, that, in the present age, it would not give to the disputant, in the judgment of men whose suffrage is of any value, the slightest advantage over his antagonist. In earlier times, indeed, the case must have been different. While the scholastic forms continued to be kept up, and while schoolmen were the sole judges of the contest, an expert logician could not fail to obtain an easy victory over an inferior proficient. *Now*, however, when the supreme tribunal to which all parties must appeal, is to be found, not *within* but *without* the walls of universities; and when the most learned dialectician must, for his own credit, avoid all allusion to the technical terms and technical forms of his art, can it be imagined that the mere possession of its rules furnishes him with invisible aid for annoying his adversary, or renders him invulnerable by some secret spell against the weapons of his assailant?* Were this really the case, one might have expected that the advocates who have undertaken its defence, (considering how much their pride was interested in the controversy) would have given us some better specimens of practical utility, in defending it against the unscientific attacks of Bacon and of Locke. It is, however, not a little remarkable, that, in every argument which they have attempted in its favour, they have not only been worsted by those very antagonists whom they accuse of ignorance, but fairly driven from the field of battle.*

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* An argument of this sort in favour of the Aristotelian logic, has, in fact, been lately alleged, in a treatise to which I have already had occasion to refer.

" Mr. Locke seems throughout to imagine that no use can be made of the doctrine of syllogisms, unless by men who deliver their reasonings in syllogistic form. That would indeed justly expose a man to the imputation of disgusting pedantry and tediousness. But, in fact, he who never uses an expression borrowed from the Aristotelic logic, may yet, unobserved, be availing himself, in the most important manner, of its use, by bringing definitions, divisions, and arguments, to the test of its rules.

" In the mere application of it to the examining of an argument which we desire to refute,—the logician will be able to bring the argument in his own mind to syllogistic form.—He will then have before his view every constituent part of the argument; some of which may have been wholly suppressed by his antagonist, and others disguised by ambiguity and declamation.—He knows every point in which it is subject to examination.—He perceives immediately, by the rules of his art, whether the premises may be acknowledged, and the conclusion denied, for want of a *vis consequentiæ*.—If not, he knows where to look for a weakness.—He turns to each of the premises, and considers whether they are false, dubious, or equivocal: and is thus prepared and directed to expose every weak point in the argument with clearness, precision, and method; and this to those who perhaps are wholly ignorant of the aids by which the speaker is thus enabled to carry conviction with his discourse." *Commentary on the compendium of Logic, used in the University of Dublin.* Dublin, 1805.

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* In most of the defences of the school logic which I have seen, the chief weapon employed has been that kind of argument which, in scholastic phraseology, is called the *Argumentum ad Hominem ;* an argument in the use of which much regard to consistency is seldom to be expected.—In one sentence, accordingly, Bacon and Locke are accused of having never read Aristotle; and, in the next, of having borrowed from Aristotle the most valuable part of their writings.

With respect to Locke, it has been triumphantly observed, that his acquaintance with Aristotle's logic must have been superficial, as he has, in one of his objections, manifestly confounded *particular* with *singular* propositions. (Commentary on the Dublin Compendium.) The criticism, I have no doubt, is just; but does it, therefore, follow, that a greater familiarity with the technical niceties of an art which he despised, would have rendered this profound thinker more capable of forming a just estimate of its scope and spirit, or of its efficacy in aiding the human understanding?—Somewhat of the same description are the attempts which have been repeatedly made to discredit the strictures of Dr. Reid, by appealing to his own acknowledgment, that there might *possibly* be some parts of the Analytics and Topics, which he had never read. The passage in which this acknowledgment is made, is so characteristical of the modesty and candour of the writer, that I am tempted to annex it to this note;—more especially, as I am persuaded, that, with many readers, it will have the effect of confirming, rather than of shaking, their confidence in the general correctness and fidelity of his researches.

" In attempting to give some account of the Analytics and of the Topics of Aristotle, ingenuity requires me to confess, that, though I have often purposed to read the whole with care, and to understand what is intelligible, yet my courage and patience always failed before I had done Why should I throw away so much time and painful attention upon a thing of

It has, indeed, been asserted by an ingenious and learned writer, that "he has never met with a person unacquainted with logic, who could state and maintain his argument with facility, clearness, and precision;—that he has seen a man of the acutest mind puzzled by the argument of his antagonist; sensible, perhaps, that it was inconclusive, but wholly unable to expose the fallacy which rendered it so: while a logician, of perhaps very inferior talents, would be able at once to *discern* and to *mark* it."[*]

I do not deny that there may be some foundation for this statement. The part of Aristotle's Organon which seems, in the design, to be the most practically useful (although it is certainly very imperfect in the execution) is the book of sophisms; a book which still supplies a very convenient phraseology for *marking* concisely some of the principal fallacies which are apt to impose on the under-

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so little real use? If I had lived in those ages when the knowledge of Aristotle's Organon entitled a man to the highest rank in philosophy, ambition might have induced me to employ upon it some years of painful study; and less, I conceive, would not be sufficient. Such reflections as these always got the better of my resolution, when the first ardour began to cool. All I can say is, that I have read some parts of the books with care, some slightly, *and some perhaps* not at all. I have glanced over the whole often, and when any thing attracted my attention, have dipped into it till my appetite was satisfied. Of all reading, it is the most dry and the most painful, employing an infinite labour of demonstration, about things of the most abstract nature, delivered in a laconic style, and often, I think, with affected obscurity; and all to prove general propositions, which, when applied to particular instances, appear self-evident." Chap. III. sect. 1.

[*] Mr. Walker, author of the Commentary on the Dublin Compendium of Logic.

standing in the heat of a *vivâ voce* dispute.* Whether it affords any aid in detecting or *discerning* these fallacies may perhaps be doubted. But it is certainly an acquisition, and an acquisition of no contemptible value, to have always at hand a set of technical terms, by which we can point out to our hearers, without circumlocution or discussion, the vulnerable parts of our antagonist's reasoning. That nothing useful is to be learned from Aristotle's logic I am far from thinking; but I believe that all which is useful in it might be reduced into a very narrow compass; and I am decidedly of opinion, that wherever it becomes a serious and favourite object of study, it is infinitely more likely to do harm than good. Indeed, I cannot help considering it as strongly symptomatic of some unsoundness in a man's judgment, when I find him disposed (after all that has been said by Bacon and Locke) to magnify its importance either as an inventive or as an argumentative Organ. Nor does this opinion rest upon theory alone. It is confirmed by all that I have observed, (if after the example of the author last quoted, I may presume to mention the results of my own observations,) with respect to the intellectual characters of the most expert dialecticians whom I have happened to know. Among these, I can with great truth say, that although I recollect several possessed of much learning, subtlety and ingenuity, I can name none who have extended by their discoveries the boundaries of science; or on whose good sense I should conceive that much reliance was to be placed in the conduct of important affairs.

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* Such phrases, for example, as, 1. *Fallacia Accidentis.* 2. *A dicto secundum quid, ad dictum simpliciter.* 3. *Ab ignorantia Elenchi.* 4. *A non causa pro causa.* 5. *Fallacia consequentis.* 6. *Petitio principii.* 7. *Fallacia plurum interrogationum, &c.*

I have mentioned those fallacies alone which are called by logicians *Fallaciæ extra Dictionem;* for as those which are called *Fallaciæ in Dictione* (such as the *Fallacia Æquivocationis, Fallacia Amphiboliæ, Fallacia Accentus vel Pronunciationis, Fallacia a Figura dictionis, &c.*) they are too contemptible to be deserving of any notice.—For some remarks on this last class of fallacies, See Note (M.)

Some very high authorities, I must, at the same time, confess, may be quoted on the opposite side of the question; among others, that of Leibnitz, unquestionably one of the first names in modern philosophy. But, on this point, the mind of Leibnitz was not altogether unwarped; for he appears to have early contracted a partiality, not only for scholastic learning, but for the projects of some of the schoolmen, to reduce, by means of technical aids, the exercise of the discursive faculty to a sort of mechanical operation;—a partiality which could not fail to be cherished by that strong bias towards synthetical reasoning from abstract maxims, which characterizes all his philosophical speculations. It must be remembered too, that he lived at a period, when logical address was still regarded in Germany as an indispensable accomplishment to all whose taste led them to the cultivation of letters or of science. Nor was this an accomplishment of easy acquisition; requiring, as it must have done, for its attainment, a long course of laborious study, and, for its successful display, a more than ordinary share of acuteness, promptitude, and invention. To all which it may be added, that while it remained in vogue, it must have been peculiarly flattering to the vanity and self-love of the possessor; securing to him, in every contest with the comparatively unskilful, an infallible triumph. These considerations, (combined with that attachment to the study of jurisprudence which he retained through life) may, I think, go far to account for the disposition which Leibnitz sometimes shows to magnify a little too much the value of this art. It is, besides, extremely worthy of remark, with respect to this eminent man, within what narrow limits he circumscribes the province of the school logic, notwithstanding the favourable terms in which he occasionally speaks of it. The following passage in one of his letters is particularly deserving of attention, as it confines the utility of syllogism to those controversies alone which are carried on in writing, and contains an explicit acknowledgment, that, in extemporaneous discussions, the use of it is equally nugatory and impracticable.

"I have myself experienced the great utility of the forms of logic in bringing controversies to an end; and wonder how it has happened, that they should have been so often applied to disputes where no issue was to be expected, while their real use has been altogether overlooked. In an argument which is carried on *vivâ voce*, it is scarcely possible that the *forms* should continue to be rigorously observed; not only on account of the tediousness of the process, but chiefly from the difficulty of retaining distinctly in the memory all the different links of a long chain. Accordingly, it commonly happens, that after one *prosyllogism*, the disputants betake themselves to a freer mode of conference. But if, in a controversy carried on in writing, the legitimate forms were strictly observed, it would neither be difficult nor disagreeable, by a mutual exchange of syllogisms and answers, to keep up the contest,* till either the point to be proved was completely established, or the disputant had nothing farther to allege in support of it. For the introduction, however, of this into practice, many rules remain to be prescribed; the greater part of which are to be collected from the practice of lawyers."*

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* The words in the original are—"non ingratum nec difficile foret, mittendo remittendoque syllogismos et responsiones, *tamdiu reciprocare serram*, donec vel confectum sit quod probandum erat, vel nihil ultra habeat quod afferat argumentator."

This concession, from so consummate a judge, I consider as of great consequence in the present argument. For my own part, if I were called on to plead the cause of the school logic, I should certainly choose to defend, as the more tenable of the two posts, that which Leibnitz has voluntarily abandoned. Much might, I think, on *this* ground be plausibly alleged in its favour, in consequence of its obvious tendency to cultivate that invaluable talent to a disputant, which Aristotle has so significantly expressed by the word *αγχινοια*;†—a talent of which the utility cannot be so forcibly pictured, as in the lively and graphical description given by Johnson, of the inconveniences with which the want of it is attended.

"There are men whose powers operate only at leisure and in retirement, and whose intellectual vigour deserts them in conversation: whom merriment confuses, and objection disconcerts; whose bashfulness restrains their exertion, and suffers them not to speak till the time of speaking is past; or whose attention to their own character makes them unwilling to utter at hazard what has not been considered and cannot be recalled."*

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* Leibnitz. Op. Tom. VI. p. 72. Edit. Dutens.

† Aristotle's definition of *αγχινοια* turns upon *one* only of the many advantages which *presence of mind* bestows in the management of a *vivâ voce* dispute. Ηδ' *αγχινοια εστιν ευστοχια τις εν ασκεπτῳ χρονῳ τȣ μεσου.* (Sagacitas est bona quædam medii conjectatio brevissimo tempore.) Analyt. Post. Lib. i. cap. 34. I use the word, upon this occasion, in that extensive and obvious sense which its etymology suggest, and in which the corresponding Latin phrase is employed by Quinctilian. "In Altercatione opus est imprimis ingenio veloci ac mobili, *animo præsenti et acri*. Non enim cogitandum, sed dicendum statim est." Quinct. Lib. vi. cap. 4.

The tendency, however, of scholastic disputations to cure these defects, it must not be forgotten, belongs to them only in common with all other habits of extemporaneous debate; and the question still recurs, Whether it it would not be wiser to look for the remedy, in exercises more analogous to the real business of life?

After having said so much in disparagement of the art of syllogizing, I feel it incumbent on me to add, that I would not be understood to represent a general acquaintance with it as an attainment of no value, even in these times. The technical language connected with it is now so incorporated with all the higher departments of learning, that, independently of any consideration of its practical applications, some knowledge of its peculiar phraseology may be regarded as an indispensable preparation both for scientific and for literary pursuits.† To the philosopher, it must ever remain a subject of speculation peculiarly interesting, as one of the most singular facts in the history of the Human Understanding. The ingenuity and subtlety of the invention, and the comprehensive reach of thought displayed in the systematical execution of so vast a design, form a proud and imperishable monument to the powers of Aristotle's mind, and leave us only to regret, that they were wasted upon objects of so little utility. In no point of view, however, does this extraordinary man appear to rise so far above the ordinary level of the species, as when we consider the dominion which he exercised, during so long a succession of ages, over the opinions of the most civilized nations. Of this dominion the basis was chiefly laid in the syllogistic theory, and in the preparatory books on the Categories and on Interpretation; a part of his works to which he was more indebted for his authority in the schools than to all the rest put together. Is it extravagant to conjecture, that Aristotle himself foresaw this; and that, knowing how prone the learned are to admire what they do not fully comprehend, and to pride themselves on the possession of a mystical jargon, unintelligible to the multitude, he resolved to

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* Life of Dryden.

† It was with great pleasure I read the concluding paragraph of the introduction prefixed to a Compend of Logic, sanctioned by so learned a body as the University of Dublin.

"Utrum hæcce ars per se revera aliquem præstet usum, quidam dubitavere. Quoniam vero in Authorum insigniorum scriptis, sæpe occurrant termini Logici, hos terminos explicatos habere, ideoque et ipsius artis partes præcipuas, omnino necessarium videtur. Hæc itaque in sequenti compendio efficere est propositum."

(Artis Logicæ Compendium. In usum Juventutis Collegii Dubliniensis.)

The arrangement of this department of academical study, proposed by M. Prevost of Geneva, seems to be very judiciously and happily imagined. "*Dialecticam*, quæ linguæ philosophicæ usum tradit, seorsim docere: et *logicam*, quæ rationis analysin instituit, ab omni de verbis disputatione sejungere visum est.

Logicam autem in tres partes dividimus: de *veritate*, de *errore*, de *methodo*: 'ut hæc mentis medicina, ad instar medicinæ corporis, exhibeat ordine statum naturalem, morbos, curationem."

See the preface to a short but masterly tract *De Probabilitate*, printed at Geneva in 1794.

adapt himself to their taste in those treatises which were destined to serve, *in the first instance*, as the foundation of his fame. If such was really his idea, the event has shown how soundly he judged of human nature, in this grand experiment upon its weakness and ductility.*

That Aristotle's works have of late fallen into general neglect, is a common subject of complaint among his idolaters. It would be nearer the truth to say, that the number of Aristotle's rational and enlightened admirers was never so great as at the present moment. In the same proportion in which his logic has lost its credit, his ethics, his politics, his poetics, his rhetoric, and his natural history, have risen in the public estimation. No similar triumph of genius is recorded in the Annals of Philosophy: —To subjugate, for so many centuries, the minds of men, by furnishing employment (unproductive as it was) to their intellectual faculties, at a time when the low state of experimental knowledge did not supply more substantial materials for their reasonings;—and afterwards, when, at the distance of two thousand years, the light of true science began to dawn, to contribute so large a share to its growing splendour.

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* The following historical sketch from *Ludoricus Vires* may serve to show, that the foregoing supposition is not altogether gratuitous. "A temporibus Platonis et Aristotelis usque ad Alexandrum Aphrodiseum, qui vixit Severo et ejus filiis Principibus, Aristoteles nominabatur magis, quam vel legebatur a doctis vel intelligebatur. Primus ille aggressus eum enarrare, et adjuvit studia multorum et ad alia in eo Philosopho quærenda excitavit. Mansit tamen crebrior in manibus hominum et notior Plato, usque ad scholas in Gallia et Italia publice constitutas, id est, quamdiu Græca et Latina lingua viguerunt. Postea vero quam theatricæ cœperunt esse disciplinæ, omnisque earum fructus existimatus est, posse disputando fucum facere, et os obturare, et pulverem ob oculos jacere, idque imperitissima peritia, et nominibus ad lubitum confictis, accomodatiores ad rem visi sunt libri logici Aristotelis et physici, *relictis permultis præclaris ejus operibus:* Platone vero, et quod ab eis non intellegeretur, quamvis multo minus Aristoteles, et quod artificium videretur docere, ne nominato quidem; non quod minorem aut ineruditiorem putem Platone Aristotelem, sed quod ferendum non est, Platonem sanctissimum philosophum præteriri, et Aristotelem ita legi, ut *meliore rejecta parte, quæ retinetur id cogatur loqui, quod ipsi jubent.*" Ludovic. Vives de Civ. Dei, l. viii. c. 10.

A remark similar to this is made by Bayle. "Ce qui doit étonner le plus les hommes sages, c'est que les professeurs se soient si furieusement entêtez des hypotheses philosophiques d'Aristote. Si l'on avoit eu cette prévention pour sa poëtique, et pour sa rhétorique, il y auroit moins de sujet de s'étonner; mais, on s'est entêté duplus foible de ses ouvrages, je veux dire, de sa logique et de sa physique."—(Bayle, Art. *Aristote*.)

In the course of the foregoing animadversions on the syllogistic theory, I have proceeded on the supposition, that the whole glory of the invention belongs to Aristotle. It is proper, however, before dismissing the subject, to take some notice of the doubts which have been suggested upon this head, in consequence of the lights recently thrown on the remains of ancient science still existing in the East. Father Pons, a Jesuit missionary, was (I believe) the first person who communicated to the learned of Europe, the very interesting fact, that the use of the syllogism is, at this day, familiarly known to the Bramins of India;* but this information does not seem to have attracted much attention in England, till it was corroborated by the indisputable testimony of Sir William Jones, in his third discourse to the Asiatic Society.† "It will be sufficient (he observes) in this dissertation to assume, what might be proved beyond controversy, that we now live among the adorers of those very deities who were worshipped under different names in Old Greece and Italy, and among the professors of those philosophical tenets, which the Ionic and Attic writers illustrated with all the beauties of their melodious language. On one hand we see the trident of Neptune, the eagle of Jupiter, the satyrs of Bacchus, the bow of Cupid, and the chariot of the sun; on another, we hear the cymbals of Rhea, the songs of the Muses, and the pastoral tales of Apollo Nomius. In more retired scenes, in groves, and in seminaries of learning, we may perceive the *Brahmans* and the *Sermanes* mentioned by Clemens, *disputing in the forms of logic*, or discoursing on the vanity of human enjoyments, on the immortality of the soul, her emanation from the eternal mind, her debasement, wanderings, and final union with her source. The six philosophical schools, whose principles are explained in the *Dersana Sastra*, comprise all the metaphysics of the old academy, the Stoa and the Lyceum; nor is it possible to read the *Vedanta*, or the many fine compositions in illustration of it, without believing that Pythagoras and Plato derived their sublime theories from the same source with the sages of India."*

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* Lettres Edifiantes et Curieuses, Tome XXVI. (old edition.)—Tome XIV. edit. of 1781. The letter is dated 1740.

† Delivered in 1786.

In a subsequent discourse, the same author mentions "a tradition, which prevailed, according to the well-informed author of the *Dabistán*, in the *Panjáb*, and in several Persian provinces, that, among other Indian curiosities, which Callisthenes transmitted to his uncle, was *a technical system of logic*, which the Brahmans had communicated to the inquisitive Greek, and which the Mohammedan writer supposes to have been the ground-work of the famous Aristotelian method. If this be true, (continues Sir W. Jones,—and none will dispute the justness of his remark,) it is one of the most interesting facts that I have met with in Asia."*

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* Works of Sir William Jones, Vol. I. p. 28.

In the same discourse, we are informed, that "the Hindoos have numerous works on grammar, *logic*, rhetoric, music, which are extant and accessible." An examination of these is certainly an object of literary curiosity, highly deserving of further attention.

Of the soundness of the opinion concerning the origin of the Greek philosophy, to which these quotations give the sanction of an authority so truly respectable, our stock of facts is as yet too scanty to enable us to form a competent judgment. Some may perhaps think, that the knowledge of the Aristotelian logic which exists in India, may be sufficiently accounted for by the Mohammedan conquests; and by the veneration in which Aristotle was held, from a very early period, by the followers of the prophet.† On

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* Eleventh discourse, delivered in 1794.

† "La philosophie Péripatétique s'est tellement établie par tout, qu'on n'en lit plus d'autre par toutes les universitez Chrétiennes. Celles mêmes, qui sont contraintes de reçevoir les impostures de Mahomet, n'enseignent les sciences que conformément aux principes du Lycée, auxquels ils s'attachent fort, qu' Averroes, Alfarabius, Albumassar, et assez d'autres philosophes Arabes se sont souvent éloignés des sentiments de leur prophête, pour ne pas contredire ceux d'Aristote, que les Turcs ont en leur idiome Turquesque et en Arabe, comme Belon le rapporte." (*La Motte le Vayer;* quoted by Bayle, Art. *Aristote.*)

"L'Auteur, dont j'emprunte ces paroles, dit dans un autre volume, que selon la relation d'Olearius, les Perses ont toutes les oeuvres d'Aristote, expliquées par beaucoup de commentaires Arabes. 'Bergeron (dit il) remarque, dans son Traité des Tartares, qu'ils possedent les livres d'Aristote,

the other hand, it must be acknowledged, that this part of Aristotle's works contains some intrinsic evidence of aid borrowed from a more ancient school. Besides that imposing appearance which it exhibits of systematical completeness in its innumerable details; and which we can scarcely suppose that it could have received from the original inventor of the art, there is a want of harmony or unity in some of its fundamental principles, which seems to betray a combination of different and of discordant theories. I allude more particularly to the view which it gives of the nature of science and of demonstration, compared with Aristotle's well-known opinions concerning the natural progress of the mind in the acquisition of knowledge. That the author of the Organon was fully aware of an incongruity so obvious, there can be little doubt; and it was not improbably with a view to disguise or to conceal it, that he was induced to avoid as much as possible, every reference to examples; and to adopt that abstract and symbolical language, which might divert the attention from the inanity of his demonstrations, by occupying it in

traduits en leur langue, enseignant, avec autant de soumission qu'on peut faire ici, sa doctrine à Samarcand, université du Grand Mogol, et à présent ville capitale du Royaume d'Usbec.' "

In the 8th volume of the Asiatic Researches, there is a paper by Dr. Balfour, containing some curious extracts (accompanied with an English version) from a Persian translation of an Arabic Treatise, entitled the "Essence of Logic." In the introduction to these extracts, Dr. Balfour mentions it as an indisputable fact, that "*the system of logic, generally ascribed to Aristotle, constitutes, at this time, the logic of all the nations of Asia who profess the Mahometan faith*;" and it seems to have been with a view of rendering this fact still more palpable to common readers, that the author has taken the trouble to translate, through the medium of the Persian, the Arabic original; from which language the knowledge of Aristotle's logic, possessed by the orientals, is supposed to have been derived.

a perpetual effort to unriddle the terms in which they are expressed.

Nor does there seem to be any thing in these suggestions (which I hazard with much diffidence) inconsistent with Aristotle's own statement, in the concluding chapter of the book of sophisms. This chapter has indeed (as far as I know) been universally understood as advancing a claim to the whole art of syllogism ;* but I must acknowledge, that it appears to me to admit of a very fair construction, without supposing the claim to comprehend *all* the doctrines delivered in the books of Analytics. In support of this idea, it may be remarked, that while Aristotle strongly contrasts the dialectical art, as taught in the preceding treatise, with the art of *disputation* as previously practised in Greece, he does not make the slightest reference to the distinction between demonstrative and dialectical syllogisms, or to those doctrines with respect to demonstration and science, which accord so ill with the general spirit of his philosophy. It does not seem, therefore, to be a very unreasonable supposition, that to these doctrines, (with which for many reasons he might judge it expedient to incorporate his own inventions and innovations) he only gave that systematical and technical form, which, by its peculiar phraseology and other imposing appendages, was calculated at once to veil their imperfections, and to gratify the vanity of those who should make them objects of study. It is surely not impossible, that the syllogistic theory may have existed as a subject of abstract speculation, long before any attempt was made to introduce the syllogism into the schools as a weapon of controversy, or to prescribe rules for the skilful and scientific management of a *vivâ voce* dispute.

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* "The conclusion of this treatise (the book of Sophisms) ought not to be overlooked : it manifestly relates, not to the present treatise only, but also to the whole Analytics and Topics of the author." Reid's Analysis, &c. Chap. v. Sect. iii.

If I were satisfied that this observation is just, I should think that nothing short of the most irresistible evidence could be reasonably opposed to the direct assertion of Aristotle. It is quite inconceivable, that he should have wilfully concealed or misrepresented the truth, at a period when there could not fail to be many philosophers in Greece, both able and willing to expose the deception.

It is true, that Aristotle's language, upon this occasion, is somewhat loose and equivocal; but it must be remembered, that it was addressed to his contemporaries, who were perfectly acquainted with the real extent of his merits as an inventor; and to whom, accordingly, it was not necessary to state his pretensions in terms more definite and explicit.

I shall only add, that this conjecture (supposing it for a moment to be sanctioned by the judgment of the learned) would still leave Aristotle in complete possession of by far the most ingenious and practical part of the scholastic logic;* while, at the same time,—should future researches verify the suspicions of Sir William Jones and others, that the first rudiments of the art were imported into Greece from the East,—it would contribute to vindicate his character against that charge of plagiarism, and of unfairness towards his predecessors, which has been admitted even by some who speak with the most unbounded reverence of his intellectual endowments.

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* This was plainly the opinion of Cicero: "In hac arte (he observes, speaking of the dialectical art, as it was cultivated by the Stoics,)—in hac arte, *si modo est hæc ars*, nullum est præceptum quomodo verum inveniatur, sed tantum est quomodo judicetur."—And a few sentences after; "Quare istam artem totam dimittamus, quæ in excogitandis argumentis muta nimium est, in judicandis nimium loquax." (De Orat. Lib. ii. 86, 87.) The first sentence is literally applicable to the doctrine of syllogism considered theoretically: the second contrasts the inutility of this doctrine with the importance of such subjects as are treated of in Aristotle's Topics.

From the logic of Aristotle, I now proceed to that of Lord Bacon; a logic which professes to guide us systematically in investigating the laws of nature, and in applying the knowledge thus acquired, to the enlargement of human power, and the augmentation of human happiness.

Of some of the fundamental rules by which this mode of philosophizing is more peculiarly distinguished, I intend to treat at considerable length;—directing my attention chiefly to such questions as are connected with the theory of our intellectual faculties. In this point of view, the author has left much to be supplied by his successors; the bent of his own genius having fortunately determined him rather to seize, by a sort of intuitive penetration, great practical results, than to indulge a comparatively sterile curiosity, by remounting to the first sources of experi-

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Whether Cicero and Quinctilian did not overrate the advantages to be derived from the study of the *Loci* as an organ of invention, is a question altogether foreign to our present inquiries. That it was admirably adapted for those argumentative and rhetorical *displays* which were so highly valued in ancient times, there can be no doubt, after what these great masters of oratory have written on the subject; but it does not follow, that, in the present state of society, it would reward the labours of those who wish to cultivate either the eloquence of the bar, or that which leads to distinction in our popular assemblies.

mental knowledge in the principles and laws of the human frame. It is to this humbler task that I propose to confine myself in the sequel. To follow him through the details of his Method, would be inconsistent with the nature of my present undertaking.

CHAPTER FOURTH.

OF THE METHOD OF INQUIRY POINTED OUT IN THE EXPERIMENTAL OR INDUCTIVE LOGIC.

SECTION I.

Mistakes of the Ancients concerning the proper object of Philosophy.—Ideas of Bacon on the same subject.—Inductive Reasoning.—Analysis and Synthesis.—Essential difference between Legitimate and Hypothetical Theories.

I HAVE had occasion to observe more than once, in the course of the foregoing speculations, that the object of physical science is *not* to trace necessary connexions, but to ascertain constant conjunctions; *not* to investigate the nature of those efficient causes on which the phenomena of the universe ultimately depend, but to examine with accuracy what the phenomena are, and what the general laws by which they are regulated.

In order to save repetitions, I here beg leave to refer to some observations on this subject in the first volume. I request more particularly the reader's attention to what I have said, in the second section of the first chapter, on the distinction between *physical* and *efficient* causes; and on the origin of that bias of the imagination which leads us to confound them under one common name. That, when we see two events constantly conjoined as antecedent and consequent, our natural apprehensions dispose us to associate the idea of causation or efficiency with the former, and to ascribe to it that power or energy by which the change was produced, is a fact obvious and unquestionable; and hence it is, that in all languages, the series of physical causes and effects is metaphorically likened to a chain, the links of which are supposed to be indissolubly and necessarily connected. The slightest reflection, at the same time, must satisfy us that these apprehensions are inconsistent, and even absurd; our knowledge of physical events reaching no farther than to the laws which regulate their succession; and the words *power* and *energy* expressing attributes not of matter but of mind. It is by a natural bias or association somewhat similar (as I have remarked in the section above-mentioned) that we connect our sensations of colour, with the primary qualities of body.*

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* Were it not for this bias of the imagination to identify efficient with physical causes, the attention would be continually diverted from the necessary business of life, and the useful exercise of our faculties suspended, in a fruitless astonishment at that hidden machinery, over which nature has drawn an impenetrable veil. To prevent this inconvenient distraction of thought, a farther provision is made in that gradual and imperceptible process by which the changes in the state of the Universe are, in general, ac-

This idea of the *object* of physical science (which may be justly regarded as the ground-work of Bacon's *Novum Organon*) differs essentially from that which was entertained by the ancients; according to whom "Philosophy is the science of *causes*." If, indeed, by *causes* they had meant merely the constant forerunners or antecedents of events, the definition would have coincided nearly with the statement which I have given. But it is evident, that by *causes* they meant such antecedents as were *necessarily* connected with the effects, and from a knowledge of which the effects might be foreseen and demonstrated: And it was owing to this confusion between the proper objects of physics and of metaphysics, that neglecting the observation of facts exposed to the examination of their senses, they vainly attempted, by synthetical reasoning, to deduce, as necessary consequences from their supposed causes, the phenomena and laws of nature. —"Causa ea est," says Cicero, "quæ id efficit cujus est causa. Non sic causa intelligi debet, ut quod cuique antecedat, id ei causa sit; sed quod cuique efficienter antecedat.—Itaque dicebat Carneades ne Apollinem quidem posse dicere futura, nisi ea, quorum causas natura ita contineret, ut ea fieri necesse esset. Causis enim efficienti-

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complished. If an animal or a vegetable were brought into being before our eyes, in an instant of time,—the event would not be in itself more wonderful than their slow growth to maturity from an embryo, or from a seed. But, on the former supposition, there is no man who would not perceive and acknowledge the immediate agency of an intelligent cause; whereas, according to the actual order of things, the effect steals so insensibly on the observation, that it excites little or no curiosity, excepting in those who possess a sufficient degree of reflection to contrast the present state of the objects around them, with their first origin, and with the progressive stages of their existence.

[illegible] scire quid fut[illegible]

[illegible] efficient with physi[illegible]
[illegible] part of the theories
[illegible] It is this which
[illegible] in ancient and modern
[illegible] omena of moving bodies
[illegible] this also which has su[illegible]

[illegible] Aristotle is equally explicit. [illegible]
[illegible]
[illegible]
[illegible] Scire autem [illegible]
sophistico modo, id est ex accidente [illegible]
[illegible] propter quam res est, ejus rei causam [illegible]
[illegible]—Analyt. Poster. Lib. i. cap. 2
[illegible] so strong a light Aristotle's idea of [illegible]
[illegible] and effects, as the analogy which [illegible]
[illegible] the links of a mathematica[illegible]
[illegible] of speakin[illegible] by his modern
[illegible] says Dr. Gillies [illegible] to deny all causa[illegible]
[illegible] to deny all demonstration.[illegible]
[illegible] "We know a mathematical [illegible]
[illegible] that make it true. In demonstration
[illegible] conclusion, and therefore prior to it.
[illegible] things in a circle, supporting the prem[illegible]
[illegible] would be to suppose that the one pro[illegible]
[illegible] sterior to the other." [illegible] p. [illegible] Cap[illegible]
[illegible] prior to another in any of [illegible]
[illegible] they are [illegible]

[illegible] Mind, Vol. I. Chap. [illegible]
[illegible]
[illegible] learned and [illegible]
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gested the simpler expedient of explaining them by the agency of *minds* united with the particles of matter.* As the communication of motion by apparent impulse, and our own power to produce motion by a volition of the mind, are two facts, of which, from our earliest infancy, we have every moment had experience; we are apt to fancy that we understand perfectly the *nexus* by which cause and effect are here necessarily conjoined; and it requires a good deal of reflection to satisfy us that, in both cases, we are as completely in the dark, as in our guesses concerning the ultimate causes of magnetism or of gravitation. The dreams of the Pythagorean school with respect to analogies or harmonies between the constitution of the universe, and the mathematical properties of figures and of numbers, were suggested by the same

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par sa force, ou son energie productive.—L'impulsion est un phénomène si commun, soumis à des lois si bien discutées, et si universelles, que toute cause qui s'y réduit semble former une classe éminente, et mériter seule le nom d' *Agent*." (*Essais de Philosophie*, Tome II. pp. 174, 175.)

I have read with great attention all that M. Prévost has so ingeniously urged in vindication of the theory of his illustrious countryman Le Sage; but without experiencing that conviction which I have in general received from his reasonings. The arguments of Locke and Hume on the other side of the question appear to my judgment, the longer I reflect on them, the more irresistible; not to mention the powerful support which they derive from the subsequent speculations of Boscovich. (See *Locke's Essay*, B. II. chap. 23. § 28, 29. and *Hume's Essay on Necessary Connexion*, Part I.)

In employing the word *misfortune*, on this occasion, I have no wish to pay an unmeaning compliment; but merely to express the painful diffidence which I always feel in my own conclusions, when they happen to be at variance with those of a writer equally distinguished by the depth and by the candour of his philosophical researches.

* To this last class of theories may also be referred the explanations of physical phenomena by such causes as sympathies, antipathies, Nature's horror of a void, &c. and other phrases borrowed by analogy from the attributes of animated beings.

idea of *necessary* connexions existing among physical phenomena, analogous to those which link together the theorems of geometry or of arithmetic; and by the same fruitless hope of penetrating, by abstract and synthetical reasoning, into the mysterious processes of nature.

Beside this universal and irresistible bias of the imagination, there were some peculiarities in the genius and scientific taste of Aristotle, which gave birth to various errors calculated to mislead his followers in their physical inquiries. Among these errors may be mentioned, as one of the most important, the distinction of causes (introduced by him) into the efficient, the material, the formal, and the final;—a distinction which, as Dr. Reid justly observes, amounts only (like many other of Aristotle's) to an explanation of the different meanings of an ambiguous word; and which, therefore, was fitter for a dictionary of the Greek language, than for a philosophical treatise.* Of the effect of this enumeration of causes in distracting the attention, some idea may be formed, when it is recollected, that, according to Aristotle, it is the business of the philosopher to reason demonstratively from all the four.†

The same predilection of Aristotle for logical or rather verbal subtilties, encouraged, for many ages, that passion for fanciful and frivolous distinctions, which is so adverse to the useful exercise of the intellectual powers. Of its tendency to check the progress of physical knowledge, the reader will be enabled to judge for himself, by perusing the 16th and 17th chapters of Mr. Harris's Philosophical Arrangements; which chapters contain a very elaborate and not inelegant view of what the author is pleased to call the ancient *Theory of Motion*. A later writer of the same school has even gone so far as to assert, that it is such researches alone which merit the title of the philosophy of Motion: and that the conclusions of Galileo and of Newton, amounting (as they unquestionably do) to nothing more than a classification and generalization of facts, deserve no higher an appellation than that of *Natural History.**

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* Analysis of Aristotle's Logic. Chap. ii. sect. 3.

† Nat. Auscult. Lib. ii. cap. 7.

In contrasting, as I have now done, the spirit of Bacon's mode of philosophising with that of the ancients, I do not mean to extol his own notions concerning the relation of cause and effect in physics, as peculiarly correct and consistent. On the contrary, it seems to me evident, that he was led to his logical conclusions, not by any metaphysical analysis of his ideas, but by a conviction founded on a review of the labours of his predecessors, that the plan of inquiry by which they had been guided, must have been erroneous. If he had perceived as clearly as Barrow, Berkeley, Hume, and many others have done since his time,† that there is not a single instance in which we are able to trace a necessary connexion between two successive events, or to explain in what manner the one follows from the other as an infallible consequence, he would have been naturally led to state his principles in a form far more concise and methodical, and to lay aside much of that scholastic jargon by which his meaning is occasionally obscured. Notwithstanding, however, this vagueness and indistinctness in his language, his comprehensive and penetrating understanding, enlightened by a discriminating survey of the fruitless inquiries of former ages, enabled him to describe, in the strongest and happiest terms, the nature, the object, and the limits of philosophical investigation. The most valuable part of his works, at the same time, consists, perhaps, in his reflections on the errors of his predecessors; and on the various causes which have retarded the progress of the sciences and the improvement of the human mind. That he should have executed, with complete success, a system of logical precepts for the prosecution of experimental inquiries, at a period when these were, for the first time, beginning to engage the attention of the curious, was altogether impossible; and yet in his *attempt* towards this undertaking, he has displayed a reach of thought and a justness of anticipation, which, when compared with the discoveries of the

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* Ancient Metaphysics, *passim*.

† In alluding to the relation between cause and effect, Bacon sometimes indulges his fancy in adopting metaphorical and popular expressions. "Namque in limine Philosophiæ, cum secundæ causæ, tanquam sensibus proximæ, ingerant se menti humanæ, mensque ipsa in illis hæreat, atque commoretur, oblivio primæ causæ obrepere possit. Sin quis ulterius pergat, *causarumque dependentiam, seriem, et concatenationem*, atque opera providentiæ intucatur, tunc secundem poetarum mythologiam, facile credet, *sum-*

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mum naturalis catenæ annulum pedi solii Jovis affigi." (De Aug. Scient. Lib. i.) This is very nearly the language of Seneca. "Cum fatum nihil aliud sit quam *series implexa causarum*, ille est prima omnium causa ex quâ ceteræ pendent."

In other instances, he speaks (and, in my opinion, much more philosophically) of the "opus quod operatur Deus a primordio usque ad finem;" a branch of knowledge which he expressly describes as placed beyond the examination of the human faculties. But this speculation, although the most interesting that can employ our thoughts, has no immediate connexion with the logic of physical science.—See Note (N.)

two succeeding centuries, seem frequently to partake of the nature of prophecy. "Prout Physica majora indies incrementa capiet, et nova axiomata educet, eo mathematicæ nova opera in multis indigebit, et plures demum fient mathematicæ mixtæ."* Had he foreseen all the researches of the Newtonian school, his language could not have been more precise or more decided.

"Bacon (it has been observed by Mr. Hume) was ignorant of geometry; and only pointed out at a distance the road to true philosophy."—"As an author and philosopher," therefore, this historian pronounces him, "*though very estimable*, yet inferior to his contemporary Galileo, perhaps even to Kepler."† The parallel is, by no means, happily imagined; inasmuch as the individuals whom it brings into contrast, directed their attention to pursuits essentially different, and were characterized by mental powers unsusceptible of comparison. As a geometer or astronomer, Bacon has certainly no claim whatever to distinction; nor can it even be said, that, as an experimentalist, he has enriched science by one important discovery; but, in just and enlarged conceptions of the proper aim of philosophical researches, and of the means of conducting them, how far does he rise above the level of his age! Nothing, indeed, can place this in so strong a light, as the history of Kepler himself; unquestionably one of the most extraordinary persons who adorned that memorable period, but deeply infected, as his writings show, with prejudices borrowed from the most remote antiquity. The mysterious theories of the Pythagorians which I formerly mentioned, and which professed to find in the mathematical properties of figures and numbers, an explanation of the system of the universe, seem, from one of his earlier publications, to have made a strong impression on his imagination;* while at an after period of life, he indulged himself in a train of thinking about the

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* De Aug. Scient. Lib. iii. Cap. vi.

By the word *Axiom*, Bacon means a general principle obtained by induction, from which we may safely proceed to reason synthetically. It is to be regretted, that he did not make choice of a less equivocal term, as Newton has plainly been misled by his example, in the very illogical application of this name to the laws of motion, and to those general *facts* which serve as the basis of our reasonings in catoptrics and dioptrics. (See pp. 40, 41, of this volume.)

I shall take this opportunity to remark, that Newton had evidently studied Bacon's writings with care; and has followed them (sometimes too implicitly) in his logical phraseology. Of this remark various other proofs will occur afterwards.

† History of England. Appendix to the reign of James I.

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* *Mysterium Cosmographicum*, de admirabili proportione orbium cœlestium deque causis cœlorum numeri, magnitudinis, motuumque periodicorum genuinis et propriis, *demonstratum per quinque regularia corpora Geometrica*, 1598. Kepler informs us, that he sent a copy of this book to Tycho Brahe; the subject of whose answer he has had the candour to record. "Argumentum literarum Brahei hoc erat, ut suspensis speculationibus à priori descendentibus, animum potius ad observationes quas simul offerebat considerandas adjicerem, inque iis primo gradu facto, posteà demum ad causas ascenderem."—To this excellent advice the subsequent discoveries, which have immortalized the name of Kepler, may (in the opinion of Mr. Maclaurin) be ascribed. *Account of Newton's Discoveries*, Book I. Chap. iii.

An aphorism of Lord Bacon, concerning the relation which Mathematics bears to Natural Philosophy, exhibits a singular contrast to the aim and spirit of the *Mysterium Cosmographicum*. "In secunda schola Platonis, Procli et aliorum, Naturalis Philosophia infecta et corrupta fuit, per Mathematicam; *quæ Philosophiam Naturalem terminare, non generare aut procreare debet*." (Nov. Org. Lib. I. Aphor. xcvi.)—The very slender knowledge of this science which Bacon probably possessed, renders it only the more wonderful, that he should have been so fortunate in seizing, or rather in divining, its genuine use and application in physical researches.

causes or the planetary motions, approaching to the speculations of the late learned author of *Ancient Metaphysics.*

"Nego (says he, in his Commentaries on the planet MARS) ullum motum perennem *non rectum* a Deo conditum esse præsidio mentali destitutum.—Hujus *motoris* manifestum est duo fore munia; alterum ut facultate polleat transvectandi corporis; alterum ut scientiâ præditus sit inveniendi circularem limitem per illam puram auram ætheriam nullis hujusmodi regionibus distinctam."—In another part of his work, he seriously gives it as his opinion, that the minds of the planets must have a power of

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The ignorance of geometry with which Mr. Hume reproaches Bacon, will not appear surprising, when it is considered, that sixty years after the time when he left Cambridge, mathematical studies were scarcely known in that University. For this fact we have the direct testimony of Dr. Wallis (afterwards Astronomical Professor at Oxford,) who was admitted at Emanuel College, Cambridge, in 1632; and who informs us, that at that time, "Mathematics were scarce looked upon as *Academical* Studies, but rather *Mechanical;* as the business of traders, merchants, seamen, carpenters, surveyors of land, and almanac-makers in London."—"Among more than two hundred students in our College, I do not know of any two who had more than I, (if so much) which was then but little; and but very few in that whole University. For the study of Mathematics was then more cultivated in London than in the Universities."

(See *an Account of some passages in the Life of Dr. Wallis,* written by himself when he was upwards of eighty, and published by Hearne, in his edition of Langtoft's Chronicle.)

The same writer, from whom this information is derived, lived to see not only the institution of the Royal Society of London, but the illustration which the University of Cambridge derived from the names of Barrow and of Newton; and even survived, for seventeen years, the publication of Newton's *Principia.*—That Lord Bacon's writings contributed, more than any other single cause, to give this sudden impulse to science in England. it is impossible to doubt.

making constant observations on the sun's apparent diameter, that they may thereby be enabled so to regulate their motions, as to describe areas proportional to the times. "Credibile est itaque, si quâ facultate præditi sint *motores* illi observandæ hujus diametri, eam tanto esse argutiorem quam sunt oculi nostri, quanto opus ejus et perennis motio nostris turbulentis et confusis negotiis est constantior.

"An ergo binos singulis planetis tribues oculos Keplere! Nequaquam. Neque est necesse. Neque enim ut moveri possint, pedes ipsis atque alæ sunt tribuendæ."

From such extravagancies as these, how wide the transition to the first sentence of the Novum Organon! "HOMO NATURÆ MINISTER ET INTERPRES TANTUM FACIT ET INTELLIGIT QUANTUM DE NATURÆ ORDINE RE VEL MENTE OBSERVAVERIT, NEC AMPLIUS SCIT AUT POTEST."

In calling man the *interpreter* of Nature, Bacon had plainly the same idea of the object of physics, which I attempted to convey, when I said, that what are commonly called the *causes* of phenomena, are only their established antecedents or *signs;* and the same analogy which this expression suggests to the fancy, has been enlarged upon at considerable length, by the inventive and philosophical Bishop of Cloyne, as the best illustration which he could give of the doctrine in question. It would be difficult, indeed, to select another equally apposite and luminous; and not less difficult to find an author equally qualified to avail himself of its aid. I shall make no apology, therefore, for borrowing his words.

"There is a certain analogy, constancy, and uniformity in the phenomena or appearances of nature, which are a foundation for general rules; and these are a grammar for the understanding of nature, or that series of effects in the visible world, whereby we are enabled to foresee what will come to pass in the natural course of things. Plotinus observes, in his third Ennead, that the art of presaging is, in some sort, the reading of natural letters denoting order; and that so far forth as analogy obtains in the universe, there may be vaticination. And in reality, he that foretells the motions of the planets, or the effects of medicines, or the results of chemical or mechanical experiments, may be said to do it by natural vaticination.

"We know a thing when we understand it, and we understand it when we can interpret or tell what it signifies. Strictly the sense knows nothing. We perceive indeed sounds by hearing, and characters by sight; but we are not therefore said to understand them. After the same manner, the phenomena of nature are alike visible to all; but all have not alike learned the connexion of natural signs, or understand what they signify, or know how to vaticinate by them. There is no question, says Socrates in *Theæteto*, concerning that which is agreeable to each person, but concerning what will in time to come be agreeable, of which all men are not equally judges. He that foreknoweth what will be, in every kind, is the wisest. According to Socrates, you and the cook may judge of a dish on the table equally well; but while the dish is making, the cook can better foretell what will ensue from this or that manner of composing it. Nor is this manner of reasoning confined only to morals or politics, but extends also to natural science.

"As the natural connexion of signs with the things signified is regular and constant, it forms a sort of rational discourse, and is therefore the immediate effect of an intelligent cause."*

The same language with respect to the office and use of philosophy has been adopted by Reid, and at a much earlier period by Hobbes; and it was evidently by a similar train of thinking (as I already hinted) that Bacon was led to call philosophy *the interpretation of nature.*

According to the doctrine now stated, the highest, or rather the only proper object of Physics, is to ascertain those established conjunctions of successive events, which constitute the order of the Universe; to record the phenomena which it exhibits to our observations, or which it discloses to our experiments; and to refer those phenomena to their general laws. While we are apt to fancy, therefore, (agreeably to popular conceptions and language) that we are investigating efficient causes, we are, in reality, only generalizing effects; and when we advance from discovery to discovery, we do nothing more than resolve our former conclusions into others still more comprehensive. It was thus that Galileo and Torricelli proceeded in proving that all terrestrial bodies gravitate towards the earth; and that the apparent levity of some of them is merely owing to the greater gravity of the atmosphere. In establishing this important conclusion, they only generalized the law of gravity, by reconciling with it a variety of seeming exceptions; but they threw no light whatever on that mysterious power, in consequence of which all these phenomena take place. In like manner, when Newton showed that the same law of gravity extends to the celestial spaces; and that the power by which the moon and planets are retained in their orbits is precisely similar in its effects to that which is manifested in the fall of a stone,—he left the efficient cause of gravity as much in the dark as ever, and only generalized still farther the conclusions of his predecessors. It was, indeed, the most astonishing and sublime discovery which occurs in the history of science;—a discovery not of less consequence in Natural Religion than in Natural Philosophy,—and which at once demonstrated (in direct contradiction to all the ancient systems) that the phenomena exhibited by the heavenly bodies, are regulated by the same laws which fall under our observation on the surface of this globe. Still, however, it was not the discovery of an efficient cause, but only the generalization of a fact.*

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* *Siris:* or a Chain of Philosophical Reflections and Inquiries concerning the virtues of Tar-Water, §§ 252, 253, 254.

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* "The laws of attraction and repulsion are to be regarded as laws of motion, and these only as rules or methods observed in the production of natural effects, the efficient and final causes whereof are not of mechanical consideration. Certainly if the explaining a phenomenon be to assign its proper efficient and final cause, it should seem the mechanical philosophers never explained any thing; their province being only to discover the laws of nature; that is, the general rules and methods of motion; and to account for particular phenomena, by reducing them under, or showing their conformity to such general rules."—Berkeley's *Siris*.

From what has been said, it is sufficiently evident, that the *ultimate* object which the philosopher aims at in his researches, is precisely the same with that which every man of plain understanding, however uneducated, has in view, when he remarks the events which fall under his observation, in order to obtain rules for the future regulation of his conduct. The more knowledge of this kind we acquire, the better can we accommodate our conduct to the established course of things; and the more are we enabled to avail ourselves of natural agents as instruments for accomplishing our purposes. It is with truth, therefore, that Bacon so often repeats, that "every accession which Man gains to his knowledge is also an accession to his power; and extends the limits of his empire over the world which he inhabits."

The knowledge of the philosopher differs from that information which is the fruit of common experience, not in kind, but in degree. The latter is, in general, confined to such facts as present themselves spontaneously to the eye; and so beautifully is the order of nature adapted to our wants and necessities, that while those laws in which we are most deeply interested are obtruded on our notice from our earliest infancy, others are more or less removed from the immediate examination of our senses, to stimu-

"The words *attraction* and *repulsion* may, in compliance with custom, be used where, accurately speaking, motion alone is meant:—Attraction cannot produce, and in that sense account for, the phenomena; being itself one of the phenomena produced and to be accounted for." Ibid.

For some very important as well as refined observations on the respective provinces of physics and of metaphysics in the theory of motion, see a Tract by Dr. Berkeley, first published at London in 1721. The title is, *De Motu; sive de Motus principio et natura, et de causa communicationis Motuum.*

late curiosity, and to present a reward to industry. That a heavy body when unsupported, will fall downwards; that a painful sensation would be felt, if the skin were punctured or lacerated; that life might be destroyed by plunging into a river, or by throwing one's self headlong from a precipice, are facts as well known to the savage as to the philosopher, and of which the ignorance would be equally fatal to both. For acquiring this, and other information of the same sort, little else is requisite than the use of our perceptive organs: And accordingly, it is familiar to every man, long before the period that, in his maturer years, falls under the retrospect of memory.

For acquiring a knowledge of facts more recondite, *observation* and *experiment* must be employed;* and, accordingly, the use of these *media* forms one of the characteristical circumstances by which the studies of the philosopher are distinguished from the experience of the multitude. How much the stock of his information must thereby be enlarged is sufficiently manifest. By habits of scientific attention, his accuracy as an observer is improved; and a precision is given to his judgment, essentially different from the vagueness of ordinary perception: by a combination of his own observations with those made by others, he arrives at many conclusions unknown to those who are prevented, by the necessary avocations of human life, from indulging the impulse of a speculative curiosity; while the experiments which his ingenuity devises, enable him to place nature in situations in which she never presents herself spontaneously to view, and to extort from her secrets over which she draws a veil to the eyes of others.*

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* To these, Condorcet adds *calculation*. "Bacon (he observes) has revealed the true method of studying nature, by employing the three instruments with which she has furnished us for the discovery of her secrets,—observation, experiment, and calculation." (*Tableau Historique des progrès de l'Esprit Humain.*) In this enumeration, it appears to me that there is a great defect in point of logical distinctness. Calculation is certainly not an instrument of discovery at all analogous to experiment and observation: it can accomplish nothing in the study of nature, till they have supplied the materials; and is indeed only one of the many arts by which we are enabled to give a greater degree of accuracy to their results. The use of optical glasses; of the thermometer and barometer; of time-pieces; and of all the various instruments of practical geometry might, with equal propriety, have been added to the list.

The advantages, at the same time, which Natural Philosophy has derived, in modern times, from the arithmetical precision thus given to scientific details, must be allowed to be immense; and they would be well entitled to an ample illustration in a system of inductive logic. To those who may wish to prosecute the subject in this view, I would beg leave to suggest the word *mensuration* as equally precise, and more comprehensive, than the word *calculation*, as employed by Condorcet.

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* These primary and essential organs of accurate information (*observation* and *experiment*) which furnish the basis to the whole superstructure of physical science, are very clearly and concisely described by *Boscovich*, in one of his notes on Stay's poem, *De Systemate Mundi*. "*Observationes* fiunt spectando id quod natura per se ipsam sponte exhibet: hujusmodi sunt observationes pertinentes ad astronomiam et historiam naturalem. *Experimenta* fiunt ponendo naturam in eas circumstantias, in quibus debeat agere et nobis ostendere id quod quærimus, quod pertinet ad physicam experimentalem. Porro et ferro et igni utimur, ac dissolvimus per vim compagem corporum, potissimum in chemiâ, et naturam quodammodo velut torquentes cogimus revelare sua secreta."

I have elsewhere remarked, that the physical discoveries of the moderns have been chiefly owing to the skilful contrivance and conduct of *experiments*; and that this method of interrogating nature was, in a great measure, unknown to the ancients. (*Philosophical Essays*, p. xxxv.) Even Aristotle himself is acknowledged, by one of his most devoted admirers, to have confined himself chiefly to *observation*; and is, on this very ground, proudly contrasted with the empirical experimentalists of the present times. "Aristotle, (says Dr. Gillies) was contented with catching nature

But the observations and experiments of the philosopher are commonly only a step towards a farther end.

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in the fact, without attempting, after the modern fashion, to put her to the torture; and in rejecting experiments operose, toilsome, or painful, either to their objects or their authors, he was justified by the habits of thinking almost universally prevalent in his age and country. Educated in free and martial republics, careless of wealth, because uncorrupted by luxury, the whole tribe of ancient Philosophers dedicated themselves to agreeable only and liberal pursuits, with too proud a disdain of arts merely useful or lucrative. They ranked with the first class of citizens; and as such, were not to be lightly subjected to unwholesome or disgusting employments. To bend over a furnace, inhaling noxious steams, to torture animals, or to touch dead bodies, appeared to them operations not more misbecoming their humanity, than unsuitable to their dignity. For such discoveries as the heating and mixing of bodies offers to inquisitive curiosity, the naturalists of Greece trusted to slaves and mercenary mechanics, whose poverty or avarice tempted them to work in metals and minerals; and to produce, by unwearied labour, those coloured and sculptured ornaments, those gems, rings, cups, and vases, and other admired but frivolous elegancies, of which (in the opinion of good judges of art) our boasted chemistry cannot produce the materials; nor, were the materials at hand, supply us with instruments fit to shape. The work-shops of tradesmen then revealed those mysteries which are now sought for in colleges and laboratories; and useful knowledge, perhaps, was not the less likely to be advanced, while the arts were confined to artists only; nor facts the more likely to be perverted, in order to support favourite theories, before the empiric had yet assumed the name, and usurped the functions of the philosopher." (Translation of Aristotle's Ethics and Politics, Vol. I. p. 161, 2d Ed.)

In another passage, we are told by the same author, that "the learning of Greece properly terminates in the Stagirite, by whom it was finally embodied into one great work; *a work rather impaired than improved by the labours of succeeding ages*." (Ibid. p. x. of the Preface)

Notwithstanding the length of this note, I must beg leave to add to it a short extract from one of the amphorisms of Lord Bacon.—" Of the *criteria* for guiding our judgment among so many different and discordant schools, there is none more to be relied on, than that which is exhibited by their *fruits;* for the fruits of any speculative doctrine, or the inventions which it has really produced, are, as it were, sponsors or vouchers for the truths which it contains. Now, it is well known, that from the philosophy of the

This end is, *first*, to resolve particular facts more simple and comprehensive; and, *secondly*, to apply these general facts (or, as they are usually called, these *laws of nature*) to a synthetical explanation of particular phenomena. These two processes of the mind, together with that judicious employment of observation and experiment which they presuppose, exhaust the whole business of philosophical investigation; and the great object of the rules of philosophising is, to show in what manner they ought to be conducted.

I. For the more complete illustration of this fundamental doctrine, it is necessary for me to recur to what has been already stated with respect to our ignorance of *efficient causes*. As we can, in no instance, perceive the link by which two successive events are connected, as to deduce, by any reasoning *a priori*, the one from the other as a consequence or effect, it follows, that when we see an event take place which has been preceded by a combination of different circumstances, it is impossible for human sagacity to ascertain whether the effect is connected with *all* the circumstances, or only with a *part* of them; and (on the latter supposition) which of the circumstances is essential to the result, and which are merely accidental accessories or concomitants. The only way, in

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Greeks, with its numerous derivative schools, hardly one experimental discovery can be collected which has any tendency to aid or to ameliorate the condition of man, or which is entitled to rank with the acknowledged principles of genuine science."—Wherefore, as in religion, faith is proved by its works, so in philosophy, it were to be wished, that those theories should be accounted vain, which, when tried by their fruits, are barren;—much more those, which, instead of grapes and olives, have produced only the thorns and thistles of controversy."—Nov. Org. Lib. i. Aph. lxiii.

such a case, of coming at the truth, is to repeat over the experiment again and again, leaving out all the different circumstances successively, and observing with what particular combinations of them the effect is conjoined. If there be no possibility of making this separation, and if, at the same time, we wish to obtain the same result, the only method of *ensuring* success is to combine together *all* the various circumstances which were united in our former trials. It is on this principle, that I have attempted, in a former chapter of this work, to account for the superstitious observances which always accompany the practice of medicine among rude nations. These are commonly ascribed to the influence of imagination, and the low state of reason in the earlier periods of society; but the truth is, that they are the necessary and unavoidable consequences of a limited experience, and are to be corrected, not by mere force of intellect, but by a more enlarged acquaintance with the established order of nature.*

Observations perfectly similar to those which I made with respect to medicine, are applicable to all the other branches of philosophy. Wherever an interesting *change* is preceded by a combination of different circumstances, it is of importance to vary our experiments in such a manner as to distinguish what is essential from what is accessory; and when we have carried the decomposition as far as we can, we are entitled to consider this simplest combination of indispensable conditions, as the *physical cause* of the event.

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* Elements of the Philosophy of the Human Mind, Vol. I. Chap. v. Part ii. Sect. i.

When by thus comparing a number of cases, agreeing in some circumstances, but differing in others, and all attended with the same result, a philosopher connects, as a general law of nature, the event with its *physical cause*, he is said to proceed according to the method of *induction*. This, at least, appears to me to be the idea which, in general, Bacon himself annexes to the phrase;* although I will not venture to affirm, that he has always employed it with uniform precision. I acknowledge, also, that it is often used by very accurate writers, to denote the whole of that system of rules, of which the process just mentioned forms the most essential and characteristical part.

The same word *induction* is employed by mathematicians in a sense not altogether different. In that general *formula* (for instance) known by the name of the Binomial Theorem, having found that it corresponds with the table of powers raised from a Binomial root, as far as it is carried by actual multiplication, we have no scruple to conclude, that it holds universally. Such a proof of a mathematical theorem is called a proof by *induction*;—a mode of speaking obviously suggested by the previous application of this term to our inferences concerning the laws of nature. There is, at the same time, notwithstanding the obvious analogy between the two cases, one very essential circumstance by which they are discriminated:—that, in mathematical induction, we are led to our conclusion (as I shall afterwards endeavour to show) by a process of thought, which, although not conformable to the rules of legitimate demonstration, involves, nevertheless, a logical inference of the understanding with respect to an universal truth or theorem; whereas, in drawing a general physical conclusion from particular facts, we are guided merely by our instinctive expectation of the continuance of the laws of nature; an expectation which, implying little, if any, exercise of the reasoning powers, operates alike on the philosopher and on the savage.

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* Inductio, quæ ad inventionem et demonstrationem scientiarum et artium erit utilis, naturam separare debet, per rejectiones et exclusiones debitas, &c. &c.—Nov. Org. Lib. i. Aph. cv.

To this belief in the permanent uniformity of physical laws, Dr. Reid long ago gave the name of the *inductive principle.* "It is from the force of this principle (he observed) that we immediately assent to that axiom upon which all our knowledge of nature is built, That effects of the same kind must have the same cause. For effects and causes, in the operations of nature, mean nothing but signs, and the things signified by them. We perceive no proper causality or efficiency in any natural cause; but only a connexion established by the course of nature between it and what is called its effects."*

A late celebrated writer, more distinguished by the singular variety and versatility of his talents, than by the depth or soundness of his understanding, was pleased to consider Reid's *inductive principle* as a fit subject of ridicule; asserting that the phenomenon in question was easily explicable by the common principles of *experience,* and the *association of ideas.* "Though no man (says he) has had any experience of what is future, every man has had experience of what *was* future."* Of the shallowness of this solution philosophers are, I believe, now very generally convinced; but even if the case were otherwise, the *fact* remarked by Reid would be equally entitled to the attention of logicians as the basis of all physical science, nor would it be easy to distinguish it by a name less liable to objection than that which he has selected.

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* Inquiry into the Human Mind, Chap. vi. Sect. 24.

In all Bacon's logical rules, the authority of this law of belief is virtually recognized, although it is nowhere formally stated in his writings; and although the doctrines connected with it do not seem to be easily reconcileable with some of his occasional expressions. It is indeed only of late that natural philosophers have been fully aware of its importance as the ground-work of the inductive logic; the earlier writers under whose review it fell having been led to consider it chiefly by its supposed subserviency to their metaphysical or to their theological speculations. Dr. Reid and M. Turgot were, so far as I know, the first who recognized its existence as an original and ultimate law of the understanding;—the source of all that experimental knowledge which we begin to acquire from the moment of our birth, as well as of those more recondite discoveries which are dignified by the name of science. It is but justice to Mr. Hume to acknowledge, that his Treatise of Human Nature furnished to Dr. Reid all the premises from which his conclusions were drawn;

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* Priestley's Examination of Reid, Beattie and Oswald, p. 85. Some very judicious and decisive strictures on this theory of Priestley may be found in Dr. Campbell's Philosophy of Rhetoric. See note at the end of the sixth Chapter of Book I.

and that he is therefore fairly entitled to the honour of having reduced logicians to the alternative of either acquiescing in his sceptical inferences, or of acknowledging the authority of some instinctive principles of belief, overlooked in Locke's Analysis.*

II. There is another circumstance which frequently adds to the difficulty of tracing the laws of nature; and which imposes on the philosopher, while carrying on the process of induction, the necessity of following a still more refined logic than has been hitherto described.—When a uniformity is observed in a number of different events, the curiosity is roused by the coincidence, and is sometimes led insensibly to a general conclusion. In a few other cases, a multiplicity of events, which appear to common observers to be altogether anomalous, are found, upon a more accurate and continued examination of them, to be subjected to a regular law.† The cycles by which the ancients predicted eclipses of the sun and moon; the two laws inferred by Kepler from the observations of Tycho Brahe; the law of refraction inferred by Snellius from the tables of Kircher and Scheiner, are instances of very comprehensive and most important rules obtained by the mere examination and comparison of particulars. Such purely *empirical discoveries*, however, are confined almost entirely to optics and astronomy, in which the physical laws combined together are comparatively few, and are insulated from the influence of those incalculable accidents which, in general, disturb the regularity of terrestrial phenomena. In by far the greater number of instances, the appearances of nature depend on a variety of different laws, all of which are often combined together in producing one single event: And, wherever such a combination happens, although each law may take place with the most complete uniformity, it is likely that nothing but confusion will strike the mere observer. A collection of such results, therefore, would not advance us one step in the knowledge of nature; nor would it enable us to anticipate the issue of one new experiment. In cases of this description, before we can avail ourselves of our past experience, we must employ our reasoning powers in comparing a variety of instances together, in order to discover, by a sort of *analysis* or decomposition, the simple laws which are concerned in the phenomenon under consideration;—after which, we may proceed safely, in determining *a priori* what the result will be of any hypothetical combination of them, whether total or partial.*

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* Note (O.)

† Philosophy of the Human Mind, Vol. I. Chap. vi. Sect. iv.

These observations have led us to the same conclusion with that which forms the great outline of Bacon's plan of philosophising; and which Newton has so successfully exemplified in his inquiries concerning gravitation and the properties of light. While they point out, too, the respective provinces and uses of the *analytic* and the *synthetic* methods, they illustrate the etymological propriety of the names by which, in the Newtonian School, they are contradistinguished from each other.

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* "Itaque naturæ facienda est prorsus solutio et separatio; non per ignem certe, sed per mentem, tanquam ignem divinum." Nov. Organ. Lib. II. Aphor. xvi. The remainder of the aphorism is equally worthy of attention; in reading which, however, as well as the rest of Bacon's philosophical works, I must request, for a reason afterwards to be mentioned, that the word *Law* may be substituted for *Form*, wherever it may occur.—An attention to this circumstance will be found of much use in studying the *Novum Organon*.

A similar idea, under other metaphorical disguises often occurs in Bacon. Considering the circumstances in which he wrote, logical precision was altogether impossible; yet it is astonishing with what force he conveys the *spirit* of the soundest philosophy of the eighteenth century. "Neque enim in plano via sita est, sed *ascendendo* et *descendendo;* ascendendo primo ad axiomata, descendendo ad opera." Nov. Org. Lib. I. Aphor. ciii.

In fact, the meaning of the words *analysis* and *synthesis*, when applied to the two opposite modes of investigation in physics, is extremely analogous to their use in the practice of chemistry. The chief difference lies in this, that, in the former case, they refer to the logical processes of the understanding in the study of *physical laws;* in the latter, to the operative processes of the laboratory in the examination of material substances.

If the foregoing remarks are well founded, they lead to the correction of an oversight which occurs in the ingenious and elegant sketch of the History of Astronomy, lately published among the posthumous works of Mr. Smith; and which seems calculated to keep out of view, if not entirely to explode that essential distinction which I have been endeavouring to establish, between the inductive logic of Bacon's followers, and the hypothetical theories of their predecessors.

"Philosophy," (says Mr. Smith) "is the science of the connecting principles of nature. Nature, after the largest experience that common observation can acquire, seems to abound with events which appear solitary and incoherent with all that go before them: which therefore disturb the easy movement of the imagination; which makes its ideas succeed each other, if one may say so, by irregular starts and sallies; and which thus tend, in some measure, to introduce a confusion, and distraction, and giddiness of mind. Philosophy, by representing the invisible chains which bind together all these disjointed objects, endeavours to introduce order into this chaos of jarring and discordant appearances; to allay this tumult of the imagination; and to restore it, when it surveys the great revolutions of the universe, to that tone of tranquillity and composure, which is both most agreeable in itself, and most suitable to its nature. Philosophy, therefore, may be regarded as one of those arts which address themselves to the imagination, by rendering the theatre of nature a more coherent, and, therefore, a more magnificent spectacle, than otherwise it would have appeared to be."

That this is *one* of the objects of philosophy, and *one* of the advantages resulting from it, I very readily admit.—But, surely, it is not the *leading* object of that plan of inductive investigation which was recommended by Bacon, and which has been so skilfully pursued by Newton. Of all philosophical systems, indeed, hypothetical or legitimate, it must be allowed, that, to a certain degree, they both please the imagination and assist the memory, by introducing order and arrangement among facts, which had the appearance, before, of being altogether unconnected and isolated. But it is the peculiar and exclusive prerogative of a system fairly obtained by the method of induction, that, while it enables us to arrange facts already known, it furnishes the means of ascertaining, by synthetic reasoning, those which we have no access to examine by direct observation. The difference, besides, among hypothetical theories, is merely a difference of *degree* arising from the greater or less ingenuity of their authors; whereas legitimate theories are distinguished from all others *radically and essentially;* and, accordingly, while the former are liable to perpetual vicissitudes, the latter are as permanent as the laws which regulate the order of the universe.

Mr. Smith himself has been led by this view of the object of philosophy, into expressions concerning the Newtonian discoveries, which seem to intimate, that, although he thought them far superior, in point of ingenuity, to any thing the world had seen before, yet that he did not consider them as so completely exclusive of a still happier system in time to come, as the Newtonians are apt to imagine. "The system of Newton" (he observes) "now prevails over all opposition, and has advanced to the acquisition of the most universal empire that was ever established in philosophy. His principles, it must be acknowledged, have a degree of firmness and solidity that we should in vain look for in any other system. The most sceptical cannot avoid feeling this. They not only connect together most perfectly all the phenomena of the heavens which had been observed before his time; but those also which the persevering industry and more perfect instruments of latter astronomers have made known to us, have been either easily and immediately explained by the application of his principles, or have been explained in consequence of more laborious and accurate calculations from these principles, than had been instituted before. And *even we*, while we have been endeavouring to represent all *philosophical systems as mere inventions of the imagination*, to connect together the otherwise disjointed and discordant phenomena of nature, have insensibly been drawn in to make use of language expressing the connecting principles of this one, as if they were the real chains which nature makes use of, to bind together her several operations."

If the view which I have given of Lord Bacon's plan of investigation be just, it will follow, That the Newtonian theory of gravitation can, in no respect whatever, admit of a comparison with those systems which are, in the slightest degree, the offspring of imagination; inasmuch as the principle employed to explain the phenomena is not a hypothesis, but a *general fact* established by induction; for which fact we have the very same evidence as for the various particulars comprehended under it. The Newtonian theory of gravitation, therefore, and every other theory which rests on a similar basis, is as little liable to be supplanted by the labours of future ages, as the mathematical conclusions of Euclid and Archimedes. The doctrines which it involves may be delivered in different, and perhaps less exceptionable forms; but, till the order of the universe shall be regulated by new physical laws, their substance must for ever remain essentially the same. On the *chains, indeed, which nature makes use of to bind together her several operations*, Newton has thrown no light whatever; nor was it the aim of his researches to do so. The subjects of his reasonings were not occult connexions, but particular phenomena, and general laws; both of them possessing all the evidence which can belong to *facts* ascertained by observation and experiment. From the one or the other of these all his inferences, whether analytical or synthetical, are deduced: Nor is a single hypothesis involved in his *data*, excepting the authority of that Law of Belief which is tacitly and necessarily assumed in all our physical conclusions,—The stability of the order of nature.

SECTION II.

Continuation of the Subject.—The Induction of Aristotle compared with that of Bacon.

In this section I intend to offer a few slight remarks upon an assertion which has been hazarded with some confidence in various late publications, that the method of investigation, so much extolled by the admirers of Lord Bacon, was not unknown to Aristotle.—It is thus very strongly stated by the ingenious author of a memoir in the Asiatic Researches."*

"From some of the extracts contained in this paper, it will appear, 1st, That the mode of reasoning by *induction*, illustrated and improved by the great Lord Verulam in his *Organum Novum*, and generally considered as the cause of the rapid progress of science in later times, was *perfectly known* to Aristotle, and was distinctly delineated by him, as a method of investigation that leads to certainty or truth: and, 2dly, That Aristotle was likewise *perfectly acquainted*, not merely with the form of induction, but with the proper materials to be employed in carrying it on—facts and experiments. We are therefore led to conclude, that all the blame of confiding the human mind for so long a time in chains, by the force of syllogism, cannot be fairly imputed to Aristotle; nor all the merit of enlarging it, and setting it free, ascribed to Lord Verulam."

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* Asiatic Researches, Vol. VIII. p. 89, 90. London Edition.

The memoir from which this passage is copied, consists of extracts translated (through the medium of the Persian) from an Arabic treatise entitled the *Essence of Logic.* When it was first presented to the Asiatic Society, the author informs us, that he was altogether ignorant of the coincidence of his own conclusions with those of Dr. Gillies; and he seems to have received much satisfaction from the subsequent perusal of the proofs alleged in support of their common opinion by that learned writer. "From the perusal of this *wonderful book,* (Dr. Gillies's exposition of the ethics and politics of Aristotle) I have now the satisfaction to discover, that the conjectures I had been led to draw from these scanty materials, are completely confirmed by the opinion of an author, who is probably better qualified than any preceding commentator on Aristotle's works, to decide on this subject."*

It is observed by Bailly, in his History of Astronomy, that, although frequent mention is made of *attraction* in the writings of the ancients, we must not therefore "conclude that they had any precise or just idea of that law into which Newton has resolved the phenomena of the planetary revolutions. To their conceptions, this word presented the notion of an occult sympathy between different objects; and if any of them extended it from the descent of terrestrial bodies to explain the manner in which the moon was retained in her orbit, it was only an exhibition upon a larger scale of the popular error."* The same author has remarked, on a different occasion, that, in order to judge of the philosophical ideas entertained at a particular period, it would be necessary to possess the dictionary of the age, exhibiting the various shades of meaning derived from fashion or from tradition. "The import of words (he adds) changes with the times: their signification enlarging with the progress of knowledge. Languages are every moment perishing in detail from the variations introduced by custom: they grow old like those that speak them, and like them gradually alter their features and their form."†

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* Ibid.

If this observation be just, with respect to the *attraction* of the ancients, when compared with the *attraction* of Newton, it will be found to apply with still greater force to the *induction* of Aristotle,‡ considered in contrast with the *induction* of Bacon.

It is well known to those who are at all conversant with Bacon's writings, that, although he borrowed many expressions from the scholastic phraseology then in vogue, he has, in general, not only employed them in new acceptations, consonant to the general spirit of his own logic, but has, by definitions or explanations, endeavoured to guard his readers against the mistakes to which they might be exposed, from a want of attention to the innovations thus introduced in the use of consecrated terms. How far he judged wisely in adopting this plan, (which has certainly much injured his style in point of perspicuity) I do not presume to decide; I wish only to state the fact:—his motives may be judged of from his own words.

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* Hist. de l'Astronomie Moderne, Tome II. pp. 555, 556.

† Ibid. p. 184.

‡ Επαγῶγη. Translated *Inductio* by Cicero.

> Nobis vero ex altera parte (quibus, quantum calamo valemus, inter vetera et nova in literis fœdus et commercium contrahere, cordi est) decretum manet, antiquitatem comitari *usque ad aras;* atque vocabula antiqua retinere, quanquam sensum eorum et definitiones sæpius immutemus; secundum moderatum illum et laudatum, in Civilibus, novandi modum, quo rerum statu novato, verborum tamen solennia durent; quod notat Tacitus: *eadem magistratuum vocabula.*"*

Of these double significations, so common in Bacon's phraseology, a remarkable instance occurs in the use which he makes of the scholastic word *forms*. In one passage, he approves of the opinion of Plato, that the investigation of *forms* is the proper object of science; adding, however, that this is not true of the *forms* which Plato had in view, but of a different sort of *forms*, more suited to the grasp of our faculties.† In another passage, he observes, that when he employs the word *forms*, in speaking of natural philosophy, he is always to be understood as meaning the *laws of nature.** Whether so accurate a reasoner as Locke would have admitted Bacon's general apology for so glaring an *abuse of words*, may perhaps be doubted: but after comparing the two foregoing sentences, would Locke (notwithstanding his ignorance of the syllogistic art) have inferred, that Bacon's opinion of the proper object of science was the same with that of Plato? The attempt to identify Bacon's induction with the induction of Aristotle, is (as I trust will immediately appear) infinitely more extravagant. It is like confounding the Christian Graces with the Graces of Heathen Mythology.

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* De Aug. Scient. Lib. iii. Cap. iv.

The necessity under which the anti-Aristotelians found themselves, in the earlier part of the 17th century, of disguising their attack on the prevailing tenets, is strongly illustrated in a letter from Des Cartes to Regius. "Pourquoi rejettez-vous publiquement *les qualités réelles* et *les formes substantielles*, si cheres aux scholastiques: J'ai déclaré que je ne prétendois pas les nier, mais que je n'en avois pas besoin pour expliquer mes pensées."

† Manifestum est, Platonem, virum sublimis ingenii (quique veluti ex rupe excelsa omnia circumspiciebat) in sua de ideis doctrina *formas esse verum scientiæ objectum*, vidisse: utcunque sententiæ hujus verissimæ fruc-

The passages in which Bacon has been at pains to guard against the possibility of such a mistake are so numerous, that it is surprising how any person, who had ever turned over the pages of the Novum Organon, should have been so unlucky as not to have lighted upon some one of them. The two following will suffice for my present purpose.

"In constituendo autem axiomate, forma inductionis alia quam adhuc in usu fuit, excogitanda est. Inductio

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tum amiserit, *formas* penitus à materia abstractas, non in materia determinatas contêmplando et prensando. Quod si diligenter, serio, et sincere, ad actionem, et usum, et oculos convertamus; non difficile erit disquirere, et notitiam assequi, quæ sint illæ *formæ*, quarum cognitio res humanas meris modis locupletare et beare possit.—De Augment. Scient. Lib. iii. Cap. iv.

* Nos quum de formis loquimur, nil aliud intelligimus, quam leges illas, quæ naturam aliquam simplicem ordinant et constituunt; ut calorem, lumen, pondus, in omnimoda materia et subjecto susceptibili. Itaque eadem res est *forma* calidi, aut *forma* luminis, et *lex* calidi, sive *lex* luminis.—Nov. Org. Lib. ii. Aph. xvii.

enim quæ procedit per *enumerationem simplicem* res puerilis est, et precario concludit. At *inductio*, quæ ad inventionem et demonstrationem scientiarum et artium erit utilis, naturam se parare debet, per rejectiones et exclusiones debitas; ac deinde post negativas tot quot sufficiunt, super affirmativas concludere; quod adhuc factum non est, nec tentatum certe, nisi tantummodo a Platone, qui ad excutiendas definitiones et ideas, hac certe forma inductionis, aliquatenus utitur. Verum ad hujus inductionis sive demonstrationis instructionem bonam et legitimam, quamplurima adhibenda sunt, quæ adhuc nullius mortalium cogitationem subiere; adeo ut in ea major sit consumenda opera, quam adhuc consumpta est in syllogismo. *Atque in hac certe inductione*, spes maxima sita est."*

———"Cogitavit et illud—Restare *inductionem*, tanquam ultimum et unicum rebus subsidium et perfugium. Verum et hujus *nomen* tantummodo notum esse; *vim et usum* homines hactenus latuisse."†

That I may not, however, be accused of resting my judgment entirely upon evidence derived from Bacon's writings, it may be proper to consider more particularly to what the induction of Aristotle really amounted, and in what respects it coincided with that to which Bacon has extended the same name.

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* Nov. Org. Lib. i. Aph. cv.

† Cogitata et Visa. The short tract to which Bacon has prefixed this title, contains a summary of what he seems to have considered as the leading tenets of his philosophical works. It is one of the most highly finished of all his pieces, and is marked throughout with an impressive brevity and solemnity, which commands and concentrates the attention. Nor does it affect to disguise that consciousness of intellectual force, which might be expected from a man destined to fix a new era in the history of human reason.—FRANCISCUS BACONUS SIC COGITAVIT, &c. &c.

"Our belief (says Aristotle in one passage) is, in every instance, founded either on syllogism or induction." To which observation he adds, in the course of the same chapter, that induction is an inference drawn from *all* the particulars which it comprehends."* It is manifest, that upon this occasion, Aristotle speaks of that induction which Bacon, in one of the extracts quoted above, describes as proceeding by simple enumeration; and which he, therefore, pronounces to be "a puerile employment of the mind, and a mode of reasoning leading to uncertain conclusions." In confirmation of Bacon's remark, it is sufficient to mention, by way of illustration, a single example; which example, to prevent cavils, I shall borrow from one of the highest logical authorities,—Dr. Wallis of Oxford.

"In an inference from induction, (says this learned writer) if the enumeration be complete, the evidence will be equal to that of a perfect syllogism; as if a person should argue, that all the planets (the Sun excepted) borrow their light from the Sun, by proving this separately of Saturn, Jupiter, Mars, Venus, Mercury, and the Moon. It is, in fact, a syllogism *in Darapti*, of which this is the form:

"*Saturn, Jupiter, Mars, Venus, Mercury, and the Moon, each borrow their light from the Sun:*
But this enumeration comprehends all the Planets, the Sun excepted:

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* First Analytics, Chap. xxiii. Vol. I. p. 126. Edit. Du Val.

Therefore all the Planets, (the Sun excepted,) borrow their light from the Sun."[*]

If the object of Wallis had been to expose the *puerility* and the *precariousness* of such an argument, he could not possibly have selected a happier illustration. The *induction* of Aristotle, when considered in *this* light, is indeed a fit companion for his syllogism; inasmuch as neither can possibly advance us a single step in the acquisition of new knowledge. How different from both is the induction of Bacon, which, instead of carrying the mind round in the same circle of words, leads it from the *past* to the *future*, from the *known* to the *unknown*?*

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[*] Institutio Logica, Lib. iii. Cap. 15. The reasoning employed by Wallis to show that the above is a legitimate syllogism *in Darapti*, affords a specimen of the facility with which a logical conjuror can transform the same argument into the most different shapes. "Siquis objiciat, hunc non esse legitimum in *Darapti* syllogismum eo quod conclusionem habeat universalem; dicendum erit, hanc universalem (qualis qualis est) esse *universalem collectivam;* quæ *singularis* est. Estque vox *omnis* hic loci (quæ dici solet) pars *Categorematica;* utpote pars termini minoris (ut ex minori propositione liquet) qui hic est (non *Planetæ* sed) *omnes Planetæ* (*excepto sole*,) seu tota collectio reliquorum (excepto sole) Planetarum, quæ *collectio* unica est; adeoque conclusio *singularis*. Quæ quidem (ut singulares aliæ) quamvis sit propositio *Universalis*, vi materiæ; non tamen talis est ut non possit esse conclusio in tertia figura. Quippe in tertia figura, quoties minor terminus, seu prædicatum minoris propositionis (adeoque subjectum conclusionis) est quid singulare, necesse estut conclusio ea sit (vi materiæ non formæ) ejusmodi universalis."

In justice to Dr. Wallis, it is proper to subjoin to these quotations, a short extract from the dedication prefixed to this treatise.—"Exampla retineo, quæ apud logicos trita sunt; ex philosophia quam vocant Veterem et Peripateticam petita: quia logicam hic trado, et quidem Peripateticam; non naturalem philosophiam. Adeoque, de quatuor elementis: de telluris quiete in universi medio; de gravium motu deorsum, leviumque sursum; de septenario planetarum numero, allisque; sic loquor, ut loqui solent Peripatetici."

Dr. Wallis afterwards very justly remarks, "that inductions of this sort are of frequent use in mathematical demonstrations; in which, after enumerating all the possible cases, it is proved, that the proposition in question is true of each of these considered separately; and the general conclusion is thence drawn, that the theorem holds universally. Thus, if it were shown, that, in all right-angled triangles, the three angles are equal to two right angles, and that the same thing is true in all acute-angled, and also in all obtuse-angled triangles; it would necessarily follow, that in *every* triangle the three angles are equal to two right angles; these three cases manifestly exhausting all the possible varieties of which the hypothesis is susceptible."

My chief motive for introducing this last passage, was to correct an idea, which, it is not impossible, may have contributed to mislead some of Wallis's readers. As the professed design of the treatise in question, was to expound the logic of Aristotle, agreeably to the views of its original author; and as all its examples and illustrations assume as truths the Peripatetic tenets, it was not unnatural to refer to the same venerated source, the few incidental reflections with which Wallis has enriched his work. Of this number is the foregoing remark, which differs so very widely from Aristotle's account of mathematical induction, that I was anxious to bring the two opinions into immediate contrast. The following is a faithful translation from Aristotle's own words:

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* "In arte jucandi (ut etiam vulgo receptum est) aut per Inductionem, aut per Syllogismum concluditur. At quatenus ad judicium, quod fit per inductionem, nihil est, quod nos detinere debeat: *uno siquidem eodemque mentis opere illud quod quæritur, et invenitur et judicatur*.—At inductionis formam vitiosam prorsus valere jubemus; legitimam ad Novum Organum remittimus."—De Aug. Scient. Lib. v. Cap. iv.

"If any person were to show, by particular demonstrations, that every triangle, separately considered, the equilateral, the scalene, and the isosceles, has its three angles equal to two right angles, he would not, *therefore*, know that the three angles of a triangle are equal to two right angles, except after a *sophistical* manner. Nor would he know this as an universal property of a triangle, although, beside these, no other triangle can be conceived to exist; for he does not know that it belongs to it *quâ* triangle: Nor that it belongs to every triangle, excepting in regard to number; his knowledge not extending to it as a property of the genus, although it is impossible that there should be an individual which that genus does not include."*

For what reason Aristotle should have thought of applying to such an induction as this the epithet *sophistical*, it is difficult to conjecture. That it is more tedious, and therefore less elegant than a general demonstration of the same theorem, is undoubtedly true; but it is not on that account the less logical, nor in point of form, the less rigorously geometrical. It is, indeed, precisely on the same footing with the proof of every mathematical proposition which has not yet been pushed to the utmost possible limit of generalization.

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* Δια τοῦτο ουδ᾽ αν τις δειξῃ καθ᾽ ἑκαστον το τριγωνον αποδειξει ἠ μιᾳ ἠ ἑτερᾳ, ὁτι δυο ορθας εχει ἑκαστον, το ισοπλευρον χωρις, και το σκαληνον, και το ισοσκελες· ουπω οιδε το τριγωνον ὅτι δυο ορθαις ισον, ει μη τον σοφιστικον τροπον· ουδε καθολου τριγωνον, ουδ᾽ ει μηδεν εστι παρα ταυτα τριγωνον ἑτερον· ου γαρ, ᾗ τριγωνον οιδεν· ουδε παν τριγωνον, αλλ᾽ ᾗ κατ᾽ αριθμον· κατ᾽ ειδος δε ου παν, και ει μηδεν εστιν ὁ ουκ οιδε.—Analyt. Poster. Lib. i. Cap. v.

I have rendered the last clause according to the best of my judgment; but in case of any misapprehension on my part, I have transcribed the author's words. It may be proper to mention, that this illustration is not produced by Aristotle as an instance of *induction;* but it obviously falls under his own definition of it, and is accordingly considered in that light by Dr. Wallis.

It is somewhat curious, that this hypothetical example of Aristotle is recorded as a historical fact by Proclus, in his commentary on Euclid. "One person, we are told, (I quote the words of Mr. Maclaurin) discovered, that the three angles of an equilateral triangle are equal to two right angles; another went farther, and showed the same thing of those that have two sides equal, and are called isosceles triangles: and it was a third that found that the theorem was general, and extended to triangles of all sorts. In like manner, when the science was farther advanced, and they came to treat of the conic sections, the plane of the section was always supposed perpendicular to the side of the cone; the parabola was the only section that was considered in the right-angled cone, the ellipse in the acute-angled cone, and the hyperbola in the obtuse-angled. From these three sorts of cones, the figures of the sections had their names for a considerable time; till, at length, Apollonius showed that they might all be cut out of any one cone, and, by this discovery, merited in those days the appellation of the Great Geometrician."*

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* Account of Sir I. Newton's Phil. Discoveries, Book i. Chap. v.

It would appear, therefore, that, in mathematics, an inductive inference may not only be demonstratively certain, but that it is a natural, and sometimes perhaps a necessary step in the generalization of our knowledge. And yet it is of one of the most unexceptionable inductive conclusions in this science, (the only science in which it is easy to conceive an enumeration which excludes the possibility of any addition) that Aristotle has spoken,—as a conclusion resting on *sophistical* evidence.

So much with respect to Aristotle's *induction*, on the supposition that the enumeration is complete.

In cases where the enumeration is imperfect, Dr. Wallis afterwards observes, "That our conclusion can only amount to a probability or to a conjecture; and is always liable to be overturned by an *instance* to the contrary." He observes also, "That this sort of reasoning is the principal instrument of investigation in what is now called *experimental philosophy;* in which, by observing and examining particulars, we arrive at the knowledge of universal truths."* All this is clearly and correctly expressed; but it must not be forgotten, that it is the language of a writer trained in the schools of Bacon and of Newton.

Even, however, the induction here described by Dr. Wallis, falls greatly short of the method of philosophising pointed out in the *Novum Organon.* It coincides exactly with those empirical inferences from mere experience, of which Bacon entertained such slender hopes for the

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* Institutio Logica.—See the Chapter De Inductione et Exemplo.

advancement of science. "Restat experientia mera; quæ si occurrat, casus; si quæsita sit, experimentum nominatur. Hoc autem experientiæ genus nihil aliud est, quam mera palpatio, quali homines noctu utuntur, omnia pertentando, si forte in rectam viam incidere detur; quibus multo satius et consultius foret, diem præstolari aut lumen accendere, deinceps viam inire. At contra, verus experientiæ ordo primo lumen accendit, deinde per lumen iter demonstrat, incipiendo ab experientia ordinata et digesta, et minime præpostera aut erratica, atque ex ea educendo axiomata, atque ex axiomatibus constitutis rursus experimenta nova, quum nec verbum divinum in rerum massam absque ordine operatum sit."*

It is a common mistake, in the logical phraseology of the present times, to confound the words *experience* and *induction* as convertible terms.† There, is indeed, between them a very close affinity; inasmuch as it is on experience alone that every legitimate induction must be raised. The process of induction therefore presupposes that of experience; but according to Bacon's views, the process of experience does by no means imply any idea of induction. Of this method Bacon has repeatedly said, that it proceeds "by means of rejections and exclusions," (that is, to adopt the phraseology of the Newtonians, in the way of *analysis*) to separate or decompose nature; so as to arrive at those axioms or general laws, from which we may infer (in the way of synthesis) other particulars formerly unknown to us, and perhaps placed beyond the reach of our direct examination.*

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* Nov. Org. Aph. lxxxii.

† "Let it always be remembered, that the author who first taught this doctrine (*that the true art of reasoning is nothing but a language accurately defined and skilfully arranged*,) had previously endeavoured to prove, that all our notions, as well as the signs by which they are expressed, originate in perceptions of sense; and that the principles on which languages are first constructed, as well as every step in their progress to perfection, all ultimately depend *on inductions from observation; in one word, on experience merely*."—Aristotle's Ethics and Politics by Gillies, Vol. I. pp. 94, 95.

In the latter of these pages, I observe the following sentence, which is of itself sufficient to show what notion the Aristotelians still annex to the word under consideration. "Every kind of reasoning is carried on either by syllogism or by induction; the former proving to us, that a particular proposition is true, because it is deducible from a general one, already known to us: and the latter demonstrating a general truth, because it holds in ALL particular cases."

But enough, and more than enough, has been already said to enable my readers to judge, how far the assertion is correct, that the induction of Bacon was well known to Aristotle. Whether it be yet *well known* to all his commentators, is a different question; with the discussion of which I do not think it necessary to interrupt any longer the progress of my work.

It is obvious, that this species of induction can never be of the slightest use in the study of nature, where the phenomena which it is our aim to classify under their general laws, are, in respect of number, if not infinite, at least incalculable and incomprehensible by our faculties.

* Nov. Org. Aph. cv. ciii.

SECTION III.

Of the Import of the Words Analysis and Synthesis, in the Language of Modern Philosophy.

As the words Analysis and Synthesis are now become of constant and necessary use in all the different departments of knowledge; and as there is reason to suspect, that they are often employed without due attention to the various modifications of their import, which must be the consequence of this variety in their applications,—it may be proper, before proceeding farther, to illustrate, by a few examples, their true logical meaning in those branches of science, to which I have the most frequent occasions to refer in the course of these inquiries. I begin with some remarks on their primary signification in *that* science, from which they have been transferred by the moderns to Physics, to Chemistry, and to the Philosophy of the Human Mind.

I.

Preliminary Observations on the Analysis and Synthesis of the Greek Geometricians.

It appears from a very interesting relic of an ancient writer,* that, among the Greek geometricians, two different sorts of analysis were employed as aids or guides to the inventive powers; the one adapted to the solution of problems; the other to the demonstration of theorems. Of the former of these, many beautiful exemplifications have been long in the hands of mathematical students; and of the latter, (which has drawn much less attention in modern times) a satisfactory idea may be formed from a series of propositions published at Edinburgh about fifty years ago.* I do not, however, know, that any person has yet turned his thoughts to an examination of the deep and subtle logic displayed in these analytical investigations; although it is a subject well worth the study of those who delight in tracing the steps by which the mind proceeds in pursuit of scientific discoveries. This *desideratum* it is not my present purpose to make any attempt to supply; but only to convey such general notions as may prevent my readers from falling into the common error of confounding the analysis and synthesis of the Greek Geometry, with the analysis and synthesis of the Inductive Philosophy.

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* Preface to the seventh book of the Mathematical Collections of Pappus Alexandrinus. An extract from the Latin version of it by Dr. Halley may be found in Note (P.)

In the arrangement of the following hints, I shall consider, in the first place, the nature and use of analysis in investigating the demonstration of *theorems*. For such an application of it, various occasions must be constantly presenting themselves to every geometer;—when engaged, for example, in the search of more elegant modes of demonstrating propositions previously brought to light; or in ascertaining the truth of dubious theorems, which from analogy, or other accidental circumstances, possess a degree of versimilitude sufficient to rouse the curiosity.

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* Propositiones Geometricæ More Veterum Demonstratæ. Auctore Matthæo Stewart, S. T. P. Matheseos in Academia Edinensi Professore, 1763.

In order to make myself intelligible to those who are acquainted only with that form of reasoning which is used by Euclid, it is necessary to remind them, that the enunciation of every mathematical proposition consists of two parts. In the first place, certain suppositions are made, and secondly, a certain consequence is affirmed to follow from these suppositions. In all the demonstrations which are to be found in Euclid's Elements (with the exception of the small number of indirect demonstrations,) the particulars involved in the hypothetical part of the enunciation are assumed as the principles of our reasoning; and from these principles a series or chain of consequences is, link by link, deduced, till we at last arrive at the conclusion which the enunciation of the proposition asserted as a truth. A demonstration of this kind is called a Synthetical demonstration.

Suppose now, that I arrange the steps of my reasoning in the reverse order; that I assume hypothetically the truth of the proposition which I wish to demonstrate, and proceed to deduce from this assumption, as a principle, the different consequences to which it leads. If, in this deduction, I arrive at a consequence which I already know to be true, I conclude with confidence, that the principle from which it was deduced is likewise true. But if, on the other hand, I arrive at a consequence which I know to be false, I conclude, that the principle or assumption on which my reasoning has proceeded is false also.—Such a demonstration of the truth or falsity of a proposition is called an Analytical demonstration.

According to these definitions of Analysis and Synthesis, those demonstrations in Euclid which prove a proposition to be true, by showing, that the contrary supposition leads to some absurd inference, are, properly speaking, analytical processes of reasoning. In *every* case, the conclusiveness of an analytical proof rests on this general maxim, That *truth* is always consistent with itself; that a supposition which leads, by a concatenation of mathematical deductions, to a consequence which is true, must itself be true; and that what necessarily involves a consequence which is absurd or impossible, must itself be false.

It is evident, that, when we are demonstrating a proposition with a view to convince another of its truth, the synthetic form of reasoning is the more natural and pleasing of the two; as it leads the understanding directly from known truths to such as are unknown. When a proposition, however, is doubtful, and we wish to satisfy our own minds with respect to it; or when we wish to discover a new method of demonstrating a theorem previously ascertained to be true; it will be found (as I already hinted) far more convenient to conduct the investigation analytically. The justness of this remark is universally acknowledged by all who have ever exercised their ingenuity in mathematical inquiries; and must be obvious to every one who has the curiosity to make the experiment. It is not, however, so easy to point out the principle on which this remarkable difference between these two opposite intellectual processes depends. The suggestions which I am now to offer appear to myself to touch upon the most essential circumstance; but I am perfectly aware that they by no meas amount to a complete solution of the difficulty.

Let it be supposed, then, either that a new demonstration is required of an old theorem; or, that a new and doubtful theorem is proposed as a subject of examination. In what manner shall I set to work, in order to discover the necessary media of proof? From the hypothetical part of the enunciation, it is probable, that a great variety of different consequences may be immediately deducible; from each of which consequences a series of other consequences will follow: At the same time, it is possible that only one or two of these trains of reasoning may lead the way to the truth which I wish to demonstrate. By what rule am I to be guided in selecting the line of deduction which I am here to pursue? The only expedient which seems to present itself, is merely tentative or experimental; to assume successively all the different *proximate consequences* as the *first link* of the chain, and to follow out the deduction from each of them, till I, at last, find myself conducted to the truth which I am anxious to reach. According to this supposition, I merely grope my way in the dark, without rule or method: the object I am in quest of, may, after all my labour, elude my search; and even, if I should be so fortunate as to attain it, my success affords me no lights whatever to guide me in future on a similar occasion.

Suppose now that I reverse this order, and prosecute the investigation analytically; assuming (agreeably to the explanation already given) the proposition to be true, and attempting, from this supposition, to deduce some acknowledged truth as a necessary consequence. I have here one fixed point from which I am to set out; or, in other words, one specific *principle* or *datum* from which all my consequences are to be deduced; while it is perfectly immaterial in what particular conclusion my deduction terminates, provided this conclusion be previously known to be true. Instead, therefore, of being limited, as before, to *one conclusion exclusively*, and left in a state of uncertainty where to *begin* the investigation, I have one single supposition marked out to me, from which my departure must necessarily be taken; while, at the same time, the path which I follow, may terminate with equal advantage in a variety of different conclusions. In the former case, the procedure of the understanding bears some analogy to that of a foreign spy, landed in a remote corner of this island, and left to explore, by his own sagacity, the road to London. In the latter case, it may be compared to that of an inhabitant of the metropolis, who wished to effect an escape, by *any one* of our seaports, to the continent. It is scarcely necessary to add, that as this fugitive,—should he happen after reaching the coast, to alter his intentions,—would easily retrace the way to his own home; so the geometer, when he has once obtained a conclusion in manifest harmony with the known principles of his science, has only to return upon his own steps, (*cæca regens filo vestigia*) in order to convert his analysis into a direct synthetical proof.

A palpable and familiar illustration (at least in some of the most essential points) of the relation in which the two methods now described stand to each other, is presented to us by the operation of unloosing a difficult knot, in order to ascertain the exact process by which it was formed. The illustration appears to me to be the more apposite, that I have no doubt it was this very analogy, which suggested to the Greek geometers the metaphorical expressions of *analysis* and of *solution*, which they have transmitted to the philosophical language of modern times.

Suppose *a knot*, of a very artificial construction, to be put into my hands as an exercise for my ingenuity, and that I was required to investigate a rule, which others, as well as myself, might be able to follow in practice, for making knots of the same sort. If I were to proceed in this attempt, according to the spirit of a geometrical *synthesis*, I should have to try, one after another, all the various experiments which my fancy could devise, till I had, at last, hit upon the particular knot I was anxious to tie. Such a process, however, would evidently be so completely tentative, and its final success would, after all, be so extremely doubtful, that common sense could not fail to suggest immediately the idea, of tracing *the knot* through all the various complications of its progress, by cautiously *undoing* or *unknitting* each successive turn of the thread in a retrogade order, from the *last* to the *first*. After gaining this *first* step, were all the former complications restored again, by an inverse repetition of the same operations which I had performed in *undoing* them, an infallible rule would be obtained for solving the problem originally proposed; and, at the same time, some address or dexterity, in the practice of the *general method*, probably gained, which would encourage me to undertake, upon future occasions, still more arduous tasks of a similar description. The parallel between this obvious suggestion of reason, and the refined logic of the Greek *analysis*, undoubtedly fails in several particulars; but both proceed so much on the same cardinal principle, as to account sufficiently for a transference of the same expressions from the one to the other. That this transference has actually taken place in the instance now under consideration, the literal and primitive import of the words ανα and λυσις, affords as strong presumptive evidence as can well be expected in any etymological speculation.

In applying the method of analysis to geometrical problems, the investigation begins by supposing the problem to be solved; after which, a chain of consequences is deduced from this supposition, terminating at last in a conclusion, which either resolves into another problem, previously known to be within the reach of our resources; or which involves an operation known to be impracticable. In the former case, all that remains to be done, is to refer to the construction of the problem in which the analysis terminates; and then, by reversing our steps, to demonstrate synthetically, that this construction fulfils all the conditions of the problem in question. If it should appear, in the course of the composition, that in certain cases the problem is possible, and in others not, the specification of these different cases, (called by the Greek geometers the διορισμος or *determination*) becomes an indispensable requisite towards a complete solution.

The utility of the ancient analysis in facilitating the solution of problems, is still more manifest than in facilitating the demonstration of theorems; and, in all probability, was perceived by mathematicians at an earlier period. The steps by which it proceeds in quest of the thing sought, are faithfully copied (as might be easily shown) from that natural logic which a sagacious mind would employ in similar circumstances; and are, in fact but a scientific application of certain rules of method, collected from the successful investigations of men who were guided merely by the light of common sense. The same observation may be applied to the analytical processes of the algebraical art.

In order to increase, as far as the state of mathematical science then permitted, the powers of their analysis, the ancients, as appears from Pappus, wrote thirty-three different treatises, (known among mathematicians by the name of τοπος αναλυομενος) of which number there are twenty-four books, whereof Pappus has particularly described the subjects and the contents. In what manner *some* of these were instrumental in accomplishing their purpose, has been fully explained by different modern writers; particularly by the late very learned Dr. Simson of Glasgow. Of Euclid's *Data*, (for example) the first in order of those enumerated by Pappus, he observes, that "it is of the most general and necessary use in the solution of problems of every kind; and that whoever tries to investigate the solutions of problems geometrically, will soon find this to be true; for the analysis of a problem requires, that consequences be drawn from the things that are *given*, until the thing that is sought be shown to be *given* also. Now, supposing that the *Data* were not extant, these consequences must, in every particular instance, be found out and demonstrated from the things given in the enunciation of the problem; whereas the possession of this elementary book supersedes the necessity of any thing more than a reference to the proposition which it contains."*

With respect to some of the other books mentioned by Pappus, it is remarked by Dr. Simson's biographer, that "they relate to general problèms of frequent recurrence in geometrical investigations: and that their use was for the more immediate resolution of any proposed geometrical problem, which could be easily reduced to a particular case of any one of them. By such a reduction the problem was considered as fully resolved; because it was then necessary only to apply the analysis, composition, and determination of that case of the general problem, to this particular problem which it was shown to comprehend."†

From these quotations it manifestly appears, that the greater part of what was formerly said of the utility of analysis in investigating the demonstration of theorems, is applicable, *mutatis mutandis*, to its employment in the solution of problems. It appears farther, that one great aim of the subsidiary books, comprehended under the title of τοπος αναλυομενος, was to multiply the number of such conclusions as might secure to the geometer a legitimate synthetical demonstration, by returning backwards, step by step, from a known or elementary construction. The obvious effect of this was, at once to abridge the analytical process, and to enlarge its resources; on a principle somewhat analogous to the increased facilities which a fugitive from Great Britain would gain, in consequence of the multiplication of our sea-ports.

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* Letter from Dr. Simson to George Lewis Scott, Esq. published by Dr Traill. See his Account of Dr. Simson's Life and Writings, p. 118.

† Ibid. pp. 159, 160

Notwithstanding, however, the immense aids afforded to the geometer by the ancient analysis, it must not be imagined that it altogether supersedes the necessity of ingenuity and invention. It diminishes, indeed, to a wonderful degree, the number of his tentative experiments, and of the paths by which he might go astray*: but (not to mention the *prospective* address which it supposes, in preparing the way for the subsequent investigation, by a suitable *construction* of the diagram,) it leaves much to be supplied at every step, by sagacity and practical skill; nor does the knowledge of it, till disciplined and perfected by long habit, fall under the description of that δυναμις αναλυτικη, which is justly represented by an old Greek writer,† as an acquisition of greater value than the most extensive acquaintance with particular mathematical truths.

According to the opinion of a modern geometer and philosopher of the first eminence, the genius thus displayed in conducting the *approaches* to a preconceived mathematical conclusion, is of a far higher order than that which is evinced by the discovery of new theorems. "Longe sublimioris ingenii est (says Galileo) alieni Problematis enodatio, aut ostensio Theorematis, quam novi cujuspiam inventio: hæc quippe fortunæ in incertum vagantibus obviæ plerumque esse solent; toto tota vero lila, quanta est, studiosissimam attentæ mentis, in unum aliquem scopumcol limantis, rationem exposcit."* Of the justness of this observation, on the whole, I have no doubt; and have only to add to it, by way of comment, that it is chiefly while engaged in the steady pursuit of a particular object, that those discoveries which are commonly considered as entirely accidental, are most likely to present themselves to the geometer. It is the methodical inquirer alone, who is entitled to expect such fortunate occurrences as Galileo speaks of; and wherever invention appears as a characteristical quality of the mind, we may be assured, that something more than chance has contributed to its success. On this occasion, the fine and deep reflection of Fontenelle will be found to apply with peculiar force: "*Ces hasards ne sont que pour ceux qui jouent bien.*"

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* "Nihil a verâ et genuinâ analysi magis distat, nihil magis abhorret, quam tentandi methodus; hanc enim amovere et certissimâ viâ ad quæsitum perducere, præcipuus est analyseos finis."

Extract from a MS. of Dr. Simson, published by Dr. Traill. See his Account, &c. p. 127.

† See the preface of Marinus to Euclid's Data. In the preface to the 7th book of Pappus, the same idea is expressed by the phrase δυναμις ευρετικη.

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* Not having the works of Galileo at hand, I quote this passage on the authority of Guido Graudi, who has introduced it in the preface to his demonstration of Huyghens's Theorems concerning the Logarithmic Line.—Vid. Hugenii Opera Reliqua, Tom. I. p. 43.

II.

Critical Remarks on the vague Use, among Modern Writers, of the Terms, Analysis *and* Synthesis.

The foregoing observations on the *Analysis* and *Synthesis* of the Greek Geometers may, at first sight, appear somewhat out of place, in a disquisition concerning the principles and rules of the Inductive Logic. As it was, however, from the mathematical Sciences, that these words were confessedly borrowed by the experimental inquirers of the Newtonian School, an attempt to illustrate their original technical import seemed to form a necessary introduction to the strictures which I am about to offer, on the loose and inconsistent applications of them, so frequent in the logical phraseology of the present times.

Sir Isaac Newton himself has, in one of his Queries, fairly brought into comparison the Mathematical and the Physical *Analysis*, as if the word, in both cases, conveyed the same idea. "*As in Mathematics, so in Natural Philosophy, the investigation of difficult things by the method of Analysis, ought ever to precede the method of Composition.* This Analysis consists in making experiments and observations, and in drawing conclusions from them by induction, and admitting of no objections against the conclusions, but such as are taken from experiments, or other certain truths. For hypotheses are not to be regarded in experimental philosophy. And although the arguing from experiments and observations by induction be no demonstration of general conclusions; yet it is the best way of arguing which the nature of things admits of, and may be looked upon as so much the stronger, by how much the induction is more general. And if no exception occur from phenomena, the conclusion may be pronounced generally. But if, at any time afterwards, any exception shall occur from experiments; it may then begin to be pronounced, with such exceptions as occur. By this way of analysis we may proceed from compounds to ingredients; and from motions to the forces producing them; and, in general, from effects to their causes; and from particular causes to more general ones, till the argument end in the most general. This is the method of analysis. And the synthesis consists in assuming the causes discovered, and established as principles, and by them explaining the phenomena proceeding from them, and proving the explanations."*

It is to the first sentence of this extract (which has been repeated over and over by subsequent writers) that I would more particularly request the attention of my readers. Mr. Maclaurin, one of the most illustrious of Newton's followers, has not only sanctioned it by transcribing it in the words of the author, but has endeavoured to illustrate and enforce the observation which it contains. "It is evident, that as in Mathematics, so in Natural Philosophy, the investigation of difficult things by the method of analysis ought ever to precede the method of composition, or the synthesis. For, in any other way, we can never be sure that we assume the principles which really obtain in nature; and that our system, after we have composed it with great labour, is not a mere dream or illusion."* The very reason here stated by Mr. Maclaurin, one should have thought, might have convinced him, that the parallel between the two kinds of analysis was not strictly correct: inasmuch as this reason ought, according to the logical interpretation of his words, to be applicable to the one science as well as to the other, instead of exclusively applying (as is obviously the case) to inquiries in Natural Philosophy.

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* See the concluding paragraphs of Newton's Optics.

After the explanation which has been already given of geometrical and also of physical analysis, it is almost superfluous to remark, that there is little, if any thing in which they resemble each other, excepting this, that both of them are methods of investigation and discovery; and that both happen to be called by the same name. This name is, indeed, from its literal or etymological import, very happily significant of the notions conveyed by it in both instances; but, notwithstanding this accidental coincidence, the wide and essential difference between the subjects to which the two kinds of analysis are applied, must render it extremely evident, that the analogy of the rules which are adapted to the one can be of no use in illustrating those which are suited to the other.

Nor is this all: The meaning conveyed by the word Analysis, in Physics, in Chemistry, and in the Philosophy of the Human Mind, is radically different from that which was annexed to it by the Greek Geometers, or which ever has been annexed to it, by any class of modern Mathematicians. In all the former sciences, it naturally suggests the idea of a decomposition of what is complex into its constituent elements. It is defined by Johnson, "a separation of a compound body into the several parts of which it consists."—He afterwards mentions, as another signification of the same word, "a solution of any thing whether corporeal or mental, to its first elements; as of a sentence to the single words; of a compound word to the particles and words which form it; of a tune to single notes; of an argument to single propositions." In the following sentence, quoted by the same author from Glanville, the word Analysis seems to be used in a sense precisely coincident with what I have said of its import, when applied to the Baconian method of investigation. "We cannot know any thing of nature but by an analysis of its true initial causes."*

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* Account of Newton's Discoveries.

In the Greek geometry, on the other hand, the same word evidently had its chief reference to the *retrograde* direction of this method, when compared with the natural order of *didactic demonstration.* Την τοιαυτην εφοδον (says Pappus) αναλυσιν καλουμεν, ὁιον αναπαλιν λυσιν; a passage which Halley thus translates: *hic processus Analysis vocatur, quasi dicas, inversa solutio.* That this is the primitive and genuine import of the preposition ἀνα, is very generally admitted by Grammarians ; and it accords, in the present instance, so happily with the sense of the context, as to throw a new and strong light on the justness of their opinion.*

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* By *the true initial causes of a phenomenon*, Glanville means, (as might be easily shown by a comparison with other parts of his works) *the simple laws form the combination of which it results*, and from a previous knowledge of which, it might have been synthetically deduced as a consequence.

That Bacon, when he speaks of those *separations of nature, by means of comparisons, exclusions, and rejections*, which form essential steps in the inductive process, had a view to the analytical operations of the chemical laboratory, appears sufficiently from the following words, before quoted. "Itaque naturæ facienda est prorsus solutio et separatio; non per ignem certe, sed per mentem, tanquam ignem divinum."

In farther proof of what I have here stated with respect to the double meaning of the words *analysis* and *synthesis*, as employed in physics and in mathematics, it may not be superfluous to add the following considerations. In mathematical analysis, we always set out from a hypothetical assumption, and our object is to arrive at some known truth, or some *datum*, by reasoning synthetically from which we may afterwards return, on our own footsteps, to the point where our investigation began. In all such cases, the synthesis is infallibly obtained by reversing the analytical process ; and as both of them have in view the demonstration of the same theorem, or the solution of the same problem, they form, in reality, but different parts of one and the same investigation. But in natural philosophy, a synthesis which merely reversed the analysis would be absurd. On the contrary, our analysis necessarily sets out from *known facts;* and after it has conducted us to a general principle, the synthetical reasoning which follows, consists always of an application of this principle to phenomena *different* from those comprehended in the original induction.

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* The force of this preposition, in its primitive sense, may, perhaps, without any false refinement, be traced more or less palpably, in every instance to which the word analysis is with any propriety applied. In what Johnson calls (for example) "the separation of a compound body into the several parts of which it consists,"—we proceed on the supposition, that these parts have *previously* been combined, or put together, so as to make up the *aggregate whole*, submitted to the examination of the chemist ; and consequently, that the analytic process follows an inverted or retrograde direction, in respect of that in which the compound is conceived to have been originally formed.—A similar remark will be found to apply (*mutatis mutandis*) to other cases, however apparently different.

In some cases, the natural philosopher uses the word Analysis, where it is probable that a Greek geometer would have used the word Synthesis. Thus, in astronomy, when we attempt from the known phenomena to establish the truth of the Copernican system, we are said to proceed analytically. But the analogy of ancient geometry would apply this word to a process directly the reverse; a process which, assuming the system as true, should reason from it to the known phenomena: after which, if the process could be so reversed as to prove that this system, and this system alone, is consistent with these facts, it would bear some analogy to a geometrical synthesis.

These observations had occurred to me, long before I had remarked, that the celebrated Dr. Hooke (guided also by what he conceived to be the analogy of the Greek geometry) uses the words analysis and synthesis in physics, precisely in the contrary acceptations to those assigned to them in the definitions of Sir Isaac Newton. "The methods (he observes) of attaining a knowledge of nature may be two; either the analytic or the synthetic. The first is the proceeding from the causes to the effects. The second, from the effects to the causes. The former is the more difficult, and supposes the thing to be already done and known, which is the thing sought and to be found out. This begins from the highest, most general, and universal principles or causes of things, and branches out itself into the more particular and subordinate. The second is the more proper for experimental inquiry, which, from a true information of the effect by a due process, finds out the immediate cause thereof, and so proceeds gradually to higher and more remote causes and powers effective, founding its steps upon the lowest and more immediate conclusions."*

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* Hooke's Posthumous Works, p. 330.

As this volume is now become extremely rare, I shall transcribe the paragraph which immediately follows the above question.

"An inquisition by the former (or analytic) method, is resembled fitly enough by the example of an architect, who hath a full comprehension of what he designs to do, and acts accordingly: But the latter (or synthetic) is more properly resembled to that of a husbandman or gardener, who prepares his ground, and sows his seed, and diligently cherishes the growing vegetable, supplying it continually with fitting moisture, food, and shelter,—observing and cherishing its continual progression, till it comes to its perfect ripeness and maturity, and yields him the fruit of his labour. Nor is it to be expected, that a production of such perfection as this is designed, should be brought to its complete ripeness in an instant; but as all the works of nature, if it be naturally proceeded with, it must have its due time to acquire its due form and full maturity, by gradual growth and a natural progression; not but that the other method is also of excellent and necessary use, and will very often facilitate and hasten the progress. An instance of which kind I designed, some years since, to have given this honourable society, in some of my lectures upon the motions and influences of the celestial bodies, if it had been then fit; but I understand, the same thing will now be shortly done by Mr. Newton, in a Treatise of his now in the press: But that will not be the only instance of that kind which I design to produce, for that I have diverse instances of the like nature, wherein, from a hypothesis being supposed, on a premeditated design, all the phenomena of the subject will be *a priori* foretold, and the effects naturally follow, as proceeding from a cause so and so qualified and limited. *And, in truth, the* SYNTHETIC *way, by experiments and observations, will be very slow, if it be not often assisted by the* ANALYTIC, *which proves of excellent use, even though it proceed by a false position; for that the discovery of a negative is one way of restraining and limiting an affirmative.*"

That Hooke was led into this mode of speaking by the phraseology of the ancient mathematicians, may, I think, be safely inferred from the following very sagacious and fortunate *conjecture* with respect to the nature of their analytical investigations, which occurs in a different part of the same volume. I do not know that any thing approaching to it is to be found in the works of any other English author prior to Dr. Halley.

"What ways the ancients had for finding out these mediums, or means of performing the thing required, we are much in the dark; nor do any of them show the way, or so much as relate that they had such a one: Yet 'tis believed, they were not ignorant of some kind of algebra, by which they had a certain way to help themselves in their inquiries, though that we now use be much confined and limited to a few media. But I do rather conceive, that they had another kind of analytics, which *went backwards* through almost all the same steps by which their demonstrations *went forwards*, though of this we have no certain account, their writings being altogether silent in that particular. However, that such a way is practicable, I may hereafter, upon some other occasion, show by some examples; whereby it will plainly appear, how much more useful it is for the finding out the ways for the solution of problems,

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Change the places of the words *analytic* and *synthetic* in this last sentence; and the remark coincides exactly with what Boscovich, Hartley, Le Sage, and many other authors, have advanced in favour of synthetical explanations from hypothetical theories. I shall have occasion afterwards to offer some additional suggestions in support of their opinion, and to point out the limitations which it seems to require.

than that which is now generally known and practised by *species*."*

The foregoing remarks, although rather of a critical than of a philosophical nature, may, I hope, be of some use in giving a little more precision to our notions on this important subject. They are introduced here, not with the most distant view to any alteration in our established language, (which, in the present instance, appears to me to be not only unexceptionable, but very happily significant of its true logical import,) but merely to illustrate the occasional influence of words over the most powerful understandings; and the vagueness of the reasonings into which they may insensibly be betrayed, by a careless employment of indefinite and ambiguous terms.

If the task were not ungrateful, it would be easy to produce numerous examples of this from writers of the highest and most deserved reputation in the present times. I must not, however, pass over in silence the name of Condillac, who has certainly contributed, more than any other individual, to the prevalence of the logical errors now under consideration. "I know well (says he, on one occasion) that it is customary to distinguish different kinds of analysis; the logical analysis, the metaphysical, and the mathematical; but there is, in fact, only *one* analysis; and it is the same in all the sciences."* On another occasion, after quoting from the logic of Port Royal a passage in which it is said, "That analysis and synthesis differ from each other only, as the road we follow in ascending from the valley differs from the road by which we ascend from the mountain into the valley."—Condillac proceeds thus: "From this comparison, all I learn is, That the two methods are contrary to one another, and consequently, that if the one be good, the other must be bad. In truth, we cannot proceed otherwise than from the known to the unknown. Now, if the thing unknown be upon the mountain, it never will be found by descending into the valley; and if it be in the valley, it will not be found by ascending the mountain. There cannot, therefore, be two contrary roads by which it is to be reached. Such opinions (Condillac adds) do not deserve a more serious criticism."†

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* Hooke's Post. Works, p. 68.

Of the illustrations here promised by Hooke of the utility of the analytical method in geometrical investigations, no traces as far as I have observed, occur in his writings. And it would appear from the following note by the editor, on the passage last quoted, that nothing important on the subject had been discovered among his papers.

"I do not *anywhere* find, that this was ever done by Dr. Hooke, and leave the usefulness therefore to be considered by the learned."

To this very extraordinary argument, it is unnecessary to offer any reply, after the observations already made on the analysis and synthesis of the Greek geometers. In the application of these two opposite methods to their respective functions, the theoretical reasoning of Condillac is contradicted by the universal experience of mathematicians, both ancient and modern; and is indeed so palpably absurd, as to carry along with it its own refutation, to the conviction of every person capable of comprehending the terms of the question. Nor would it be found more conclusive or more intelligible, if applied to the analysis and synthesis of natural philosophers; or indeed to these words, in any of the various acceptations in which they have ever hitherto been understood. As it is affirmed, however, by Condillac, that "there neither is, nor can be, more than *one* analysis," a refutation of his reasoning, drawn from any particular science, is, upon his own principle, not less conclusive, than if founded on a detailed examination of the whole circle of human knowledge. I shall content myself, therefore, on the present occasion, with a reference to the mathematical illustrations contained in the former part of this section.

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* La Logique, Seconde Partie, Chap. vii.

† Ibid. Chap. vi.

With regard to the notion annexed to this word by Condillac himself, I am not certain, if, after all that he has written in explanation of it, I have perfectly seized his meaning. "To analyze, (he tells us, in the beginning of his Logic) is nothing more than to observe in *a successive order* the qualities of an object with the view of giving them in the mind that *simultaneous order* in which they co-exist."* In illustration of this definition, he proceeds to remark, That "although with a single glance of the eye a person may discover a multitude of objects in an open champaign which he has previously surveyed with attention, yet that the prospect is never more distinct, than when it is circumscribed within narrow bounds, and only a small number of objects is taken in at once. We always discern with accuracy but a part of what we see."

"The case (he continues) is similar with the intellectual eye. I have, at the same moment, present to it, a great number of the familiar objects of my knowledge. I see the whole group, but am unable to mark the discriminating qualities of individuals. To comprehend with distinctness all that offers itself simultaneously to my view, it is necessary that I should, in the first place, decompose the mass;—in a manner analogous to that in which a curious observer would proceed in decomposing, by successive steps, the coexistent parts of a landscape.—It is necessary for me, in other words, to *analyse* my thoughts."*

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* La Logique, Première Partie, Chap. ii.

The same author afterwards endeavours still farther to unfold his notion of analysis, by comparing it to the natural procedure of the mind in the examination of a machine. "If I wish (says he) to understand a machine, I decompose it, in order to study separately each of its parts. As soon as I have an exact idea of them all, and am in a condition to replace them as they were formerly, I have a perfect conception of the machine, having both decomposed and recomposed it."†

In all this, I must confess, there seems to me to be much both of vagueness and of confusion. In the two first quotations, the word analysis is employed to denote nothing more than that separation into parts, which is necessary to bring a very extensive or a very complicated subject within the grasp of our faculties;—a description, certainly, which conveys but a very partial and imperfect conception of *that* analysis which is represented as the great organ of invention in all of the sciences and arts.* In the example of the machine, Condillac's language is somewhat more precise and unequivocal; but when, examined with attention, will be found to present an illustration equally foreign to his purpose. This is the more surprising, as the instance here appealed to might have been expected to suggest a juster idea of the method in question, than that which resolves into a literal *de*-composition and *re*-composition of the thing to be analyzed. That a man may be able to execute *both* of these manual operations on a machine, without acquiring any clear comprehension of the manner in which it performs its work, must appear manifest on the slightest reflection; nor is it less indisputable, that another person without disengaging a single wheel, may gain, by a process purely intellectual, a complete knowledge of the whole contrivance. Indeed, I apprehend, that it is in this way alone that the theory of any complicated machine *can* be studied; for it is not the parts, separately considered, but the due combination of these parts, which constitutes the mechanism.† An observer, accordingly, of common sagacity, is here guided by the logic of nature, to a species of analysis, bearing as much resemblance to those of mathematicians and of natural philosophers, as the very different nature of the cases admits of. Instead of allowing his eye to wander at large over the perplexing mazes of such a labyrinth, he begins by remarking the ultimate *effect:* and thence proceeds to trace backwards, step by step, the series of intermediate movements by which it is connected with the *vis motrix*. In doing so, there is undoubtedly a sort of *mental* decomposition of the machine, inasmuch as all its parts are successively considered in detail; but it is not this decomposition which constitutes the *analysis*. It is the methodical *retrogradation* from the mechanical effect to the mechanical power.*

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* Ibid. In this last paragraph, I have introduced one or two additional clauses, which seemed to me necessary for conveying clearly the author's idea. Those who take the trouble to compare it with the original, will be satisfied, that, in venturing on these slight interpolations, I had no wish to misrepresent his opinion.

† Ibid. Chap. iii.

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* Ce qu'on nomme *methodé d'invention*, n'est autre chose que l'analyse. C'est elle qui a fait toutes les découvertes; c'est par elle que nous retrouverons tout ce qui a été trouvé. Ibid.

† If on any occasion, a literal decomposition of a machine should be found necessary, it can only be to obtain a view of some of its parts, which in their combined state, are concealed from observation.

The passages in Condillac to which these criticisms refer, are all selected from his treatise on Logic, written purposely to establish his favourite doctrine with respect to the influence of language upon thought. The paradoxical conclusions into which he himself has been led by an unwarrantable use of the words Analysis and Synthesis, is one of the most remarkable instances which the history of modern literature furnishes of the truth of his general principle.

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* That this circumstance of *retrogradation* or *inversion*, figured more than any other in the imagination of Pappus, as the characteristical feature of geometrical analysis, appears indisputably from a clause already quoted from the preface to his 7th Book ;—Την τοιαυτην εφοδον αναλυσιν καλουμεν οιον αναπαλιν λυσιν. To say, therefore, as many writers have done, that the analysis of a geometrical problem consists in *decomposing* or *resolving* it in such a manner as may lead to the discovery of the *composition* or synthesis, —is at once to speak vaguely, and to keep out of view the cardinal principle on which the utility of the method hinges. There is indeed one species of *decomposition* exemplified in the Greek geometry;—*that* which has for its object to distinguish all the various cases of a general problem; but this part of the investigation was so far from being included by the ancients in their idea of analysis, that they bestowed upon it an appropriate name of its own;—the three requisites to a complete solution being (according to Pappus) αναλυσαι, ϗ συνθειναι, ϗ διοριζεσθαι κατα πτωσιν.

Nor does this observation apply merely to the productions of his more advanced years. In early life, he distinguished himself by an ingenious work, in which he professed to trace *analytically* the history of our sensations and perceptions; and yet, it has been very justly remarked of late, that all the reasonings contained in it are purely *synthetical*. A very eminent mathematician of the present times has even gone so far as to mention it "as a model of *geometrical* synthesis."* He would, I apprehend, have expressed his idea more correctly, if, instead of the epithet *geometrical*, he had employed, on this occasion, *logical* or *metaphysical*; in both of which sciences, as was formerly observed, the analytical and synthetical methods bear a much closer analogy to the experimental inductions of chemistry and of physics, than to the abstract and hypothetical investigations of the geometer.

The abuses of language which have been now under our review, will appear the less wonderful, when it is considered that mathematicians themselves do not always speak of analysis and synthesis with their characteristical precision of expression; the former word being frequently employed to denote *the modern calculus*, and the latter, *the pure geometry of the ancients*. This phraseology, although it has been more than once censured by foreign writers, whose opinions might have been expected to have some weight, still continues to prevail very generally upon the Continent. The learned and judicious author of the History of Mathematics complained of it more than fifty years ago; remarking the impropriety "of calling by the name of the *synthetic method*, that which employs no algebraical *calculus*, and which addresses itself to the mind and to the eyes, by means of diagrams, and of reasonings expressed at full length in ordinary language. It would be more exact (he observes farther) to call it *the method of the ancients*, which, (as is now universally known,) virtually supposes, in all its synthetical demonstrations, the previous use of analysis. As to the algebraical calculus, it is only an abridged manner of expressing a process of mathematical reasoning;—which process may according to circumstances, be either analytical or synthetical. Of the latter, an elementary example occurs in the algebraical demonstrations given by some editors of Euclid, of the propositions in his second Book."*

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* M. Lacroix. See the Introduction to his Elements of Geometry.

This misapplication of the words analysis and synthesis, is not, indeed, attended with any serious inconveniences, similar to the errors occasioned by the loose phraseology of Condillac. It were surely better, however, that mathematicians should cease to give it the sanction of their authority, as it has an obvious tendency,—beside the injustice which it involves to the inestimable remains of Greek geometry,—to suggest a totally erroneous theory, with respect to the real grounds of the unrivalled and transcendent powers possessed by the modern *calculus*, when applied to the more complicated researches of physics.†

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* Histoire des Mathématiques, par Montucla, Tome Premier, pp. 175, 176

† In the ingenious and profound work of M. De Gerando, entitled, *Des Signes et de l'Art de Penser, considérés dans leur rapports mutuels*, there is a very valuable chapter on the Analysis and Synthesis of metaphysicians and of geometers. (See Vol. IV. p. 172.) The view of the subject which I have taken in the foregoing section, has but little in common with that

SECTION IV.

The Consideration of the Inductive Logic resumed.

I.

Additional Remarks on the distinction between Experience and Analogy.—Of the grounds afforded by the latter for Scientific Inference and Conjecture.

IN the same manner in which our external senses are struck with that resemblance between different *individuals* which gives rise to a common appellation, our superior faculties of observation and reasoning, enable us to trace those more distant and refined similitudes which lead us to comprehend different species under one common *genus*. Here, too, the principles of our nature, already pointed out, dispose us to extend our conclusions from what is familiar to what is comparatively unknown: and to reason from species to species, as from individual to individual. In both instances, the logical process of thought is nearly, if not exactly, the same; but the common use of language has established a verbal distinction between them; our most correct writers being accustomed

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given by this excellent philosopher; but in one or two instances, where we have both touched upon the same points, (particularly in the strictures upon the logic of Condillac) there is a general coincidence between our criticisms, which adds much to my confidence in my own conclusions.

(as far as I have been able to observe) to refer the evidence of our conclusions, in the one case, to *experience*, and in the other to *analogy*. The truth is, that the difference between these two denominations of evidence, when they are accurately analyzed, appears manifestly to be a difference, not in *kind*, but merely in *degree*; the discriminative peculiarities of individuals invalidating the inference, as far as it rests on experience solely, as much as the characteristical circumstances which draw the line between different *species* and different *genera*.*

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* In these observations on the import of the word *analogy*, as employed in philosophical discussions, it gives me great pleasure to find, that I have struck nearly into the same train of thinking with M. Prévost. I allude more particularly to the following passage in his *Essais de Philosophie*.

"Le mot *Analogie*, dans l'origine, n'exprime que la ressemblance. Mais l'usage l'applique à une ressemblance éloignée: d'ou vient que les conclusions analogiques sont souvent basardées, et ont besoin d'être déduites avec art. Toutes les fois donc que, dans nos raisonnemens, nous portons des jugemens semblables sur des objets qui n'ont qu'une ressemblance éloignée, nous raisonnons analogiquement. La ressemblance prochaine est celle qui fonde la première généralisation, celle qu'on nomme *l'espèce*. On nomme éloignée la ressemblance qui fonde les généralisations superieures, c'est-à-dire, le *genre* et ses divers degrés. Mais cette definition n'est pas rigoureusement suivie.

"Quoiqu'il en soit, on conçoit des cas, entre lesquels la ressemblance est si parfaite, qu'il ne s'y trouve aucune différence sensible, si ce n'est celle du tems et du lieu. Et il est des cas dans lesquels on apperçoit beaucoup de ressemblance, mais où l'on decouvre aussi quelques différences indépendantes de la diversité du temps et du lieu. Lorsque nous ferons un jugement general, fondé sur la première espèce de ressemblance, nous dirons que nous usons de la *méthode d'induction*. Lorsque la seconde espèce de ressemblance autorisera nos raisonnemens, nous dirons que c'est de la *méthode d'analogie* que nous faisons usage. On dit ordinairement que la méthode d'induction conclut du particulier au général, et que la methode d'analogie conclut du semblable au semblable. Si l'on analyse ces defini-

This difference in point of degree (it must at the same time be remembered) leads, where it is great, to important consequences. In proportion as the resemblance between two cases diminishes in the palpable marks which they exhibit to our senses, our inferences from the one to the other are made with less and less confidence; and therefore it is perfectly right, that we should reason with more caution from *species* to *species*, than from *individual* to *individual* of the same kind. In what follows, accordingly, I shall avail myself of the received distinction between the words *experience* and *analogy*; a distinction which I have hitherto endeavoured to keep out of view, till I should have an opportunity of explaining the precise notion which I annex to it. It would, in truth, be a distinction of important use in our reasonings, if the common arrangements, instead of originating, as they have often done, in ignorance or caprice, had been really the result of an accurate observation and comparison of particulars. With all the imperfections of these arrangements, however, a judicious inquirer will pay so much regard to prevailing habits of thinking, as to distinguish very scrupulously what common language refers to experience from what it refers to analogy, till he has satisfied himself, by a diligent examination, that the distinction has, in the instance before him, no foundation in truth. On the other hand, as mankind are much more disposed to confound things which ought to be distinguished, than to distinguish things which are exactly or nearly similar, he will be doubly

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tions, on verra que nous n'avons fait autre chose que leur donner de la précision." (Essais de Philosophie, Tome II. p. 202.)

See also the remarks on induction and analogy in the four following articles of M. Prévost's work.

cautious in concluding, that all the knowledge which common language ascribes to experience is equally solid; or that all the conjectures which it places to the account of analogy are equally suspicious.

A different idea of the nature of analogy has been given by some writers of note; and it cannot be denied, that, in certain instances, it seems to apply still better than that proposed above. The two accounts, however, if accurately analyzed, would be found to approach much more nearly, than they appear to do at first sight; or rather, I am inclined to think, that the one might be resolved into the other, without much straining or over-refinement. But this is a question chiefly of speculative curiosity, as the general remarks which I have now to offer, will be found to hold, with respect to analogy, considered as a ground of philosophical reasoning, in whatever manner the word is defined; provided only it be understood to express some sort of correspondence or affinity between two subjects, which serves, as a principle of association or of arrangement, to unite them together in the mind.

According to Dr. Johnson, (to whose definition I allude more particularly at present) analogy properly means "a resemblance between things *with regard to some circumstances or effects;* as when learning is said to *enlighten* the mind;—that is, to be to the mind what light is to the eye, by enabling it to discover that which was hidden before." The statement is expressed with a precision and justness not always to be found in the definitions of this author; and it agrees very nearly with the notion of analogy adopted by Dr. Ferguson,—that "things which have no resemblance to each other may nevertheless be analogous; analogy consisting in a resemblance or correspondence of relations."* As an illustration of this, Dr. Ferguson mentions the analogy between the fin of a fish and the wing of a bird; the fin bearing the same relation to the water, which the wing does to the air. This definition is more particularly luminous, when applied to the analogies which are the foundation of the rhetorical figures of metaphor and allusion; and it applies also very happily to those which the fancy delights to trace between the material and the intellectual worlds; and which (as I have repeatedly observed,) are so apt to warp the judgment in speculating concerning the phenomena of the human mind.

The pleasure which the fancy receives from the contemplation of such correspondences, real or supposed, obviously presupposes a certain *disparity* or *contrast* in the natures of the two subjects compared; and, therefore, analogy forms an associating principle, specifically different from resemblance, into which Mr. Hume's theory would lead us to resolve it. An additional proof of this is furnished by the following consideration, That a resemblance of *objects or events* is perceived by *sense*, and accordingly has some effect even on the lower animals; a *correspondence* (or, as it is frequently called, a *resemblance*) of *relations*, is not the object of sense, but of *intellect*, and consequently, the perception of it implies the exercise of reason.

Notwithstanding, however, the radical distinction between the notions expressed by the words resemblance and analogy, they may often approach very nearly to each other in their meaning: and cases may even be conceived, in which they exactly agree. In proof of this, it is sufficient to remark, that in objects, the parts of which respectively exhibit that correspondence which is usually distinguished by the epithet *analogous*, this correspondence always deviates, less or more, from an exact conformity or identity; insomuch, that it sometimes requires a good deal of consideration to trace in detail the parallel circumstances, under the disguises which they borrow from their diversified combinations. An obvious instance of this occurs when we attempt to compare the bones and joints in the leg and foot of a man with those in the leg and foot of a horse. Were the correspondence in all the *relations* perfectly exact, the *resemblance* between the two objects would be manifest even to sense; in the very same manner that, in geometry, the *similitude* of two triangles is a necessary consequence of a precise correspondence in the *relations* of their homologous sides."*

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* Principles of Moral and Political Science. Vol. I. p. 107.

This last observation may serve, in some measure, to justify an assertion which was already hazarded,—That the two definitions of analogy formerly mentioned, are very nearly allied to each other;—inasmuch as it shows, by a more careful analysis than has commonly been applied to this subject, that the sensible *dissimilitude* between things of different *species* arises chiefly from the want of a palpable conformity in the *relations* of their constituent parts. Conceive *that* more remote correspondence which reason or fancy traces between the parts of the one and the parts of the other, gradually to approach nearer and nearer to the same standard; and it is evident, that, in the course of the approximation, you will arrive at that degree of manifest resemblance, which will bring them under the same generic name; till at last, by continuing this process of the imagination, the one will become a correct picture or image of the other, not only in its great outlines, but in its minutest details.

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* See Note (Q.)

From this view of the subject, too, as well as from the former, it appears, how vague and ill defined the metaphysical limits are which separate the evidence of analogy from that of experience; and how much room is left for the operation of good sense, and of habits of scientific research, in appreciating the justness of that authority which, in particular instances, the popular forms of speech may assign to either.

The illustrations which I have to offer of this last remark, in so far as it relates to *experience*, may, I think, be introduced more usefully afterwards; but the vague conceptions which are generally annexed to the word *analogy*, together with the prevailing prejudices against it, as a ground of philosophic reasoning, render it proper for me, before proceeding any farther, to attempt the correction of some popular mistakes connected with the use of this obnoxious term.

It is not necessary, for the purposes which I have at present in view, to investigate very curiously the principles which, in the first instance, dispose the mind to indulge in analogical conjectures from the known to the unknown. It is sufficient to observe, that this disposition, so far from being checked, receives additional encouragement from habits of philosophical study;—the natural tendency of these habits being only to guide it into the right path, and, to teach it to proceed cautiously, according to certain general rules, warranted by experience.

The encouragement which philosophical pursuits give to this natural disposition, arises chiefly from the innumerable proofs they afford of that systematical unity and harmony of design which are everywhere conspicuous in the universe. On this unity of design is founded the most solid argument which the light of reason supplies for the unity of God; but the knowledge of *the general fact* on which that argument proceeds is not confined to the student of theology. It forces itself irresistibly on the thoughts of all who are familiarly conversant with the phenomena, either of the material or of the moral world; and is recognized as a principle of reasoning, even by those who pay little or no attention to its most sublime and important application.

It is well known to all who have the slightest acquaintance with the history of medicine, that the anatomical knowledge of the ancients was derived almost entirely from analogical conjectures, founded on the dissection of the lower animals;* and that, in consequence of this, many misrepresentations of facts, and many erroneous theories (blended, however, with various important truths,) were transmitted to the physiologists of modern Europe. What is the legitimate inference to be deduced from these premises? Not, surely, that analogy is an organ of *no* use in the study of nature; but that, although it may furnish a rational ground of conjecture and inquiry, it ought not to be received as direct evidence, where the fact itself lies open to examination; and that the conclusions to which it leads ought, in every case, to be distrusted, in proportion as the subjects compared depart from an exact coincidence in all their circumstances.

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* "If we read the works of Hippocrates with impartiality, and apply his accounts of the parts to what we *now* know of the human body, we must allow his descriptions to be imperfect, incorrect, sometimes extravagant, and often unintelligible, that of the bones only excepted. He seems to have studied these with more success than the other parts, and tells us, that he had an opportunity of seeing a human skeleton." . . . . .

"Erasistratus and Herophilus, two distinguished anatomists at Alexandria, were probably the first who were authorized to dissect human bodies.

As our knowledge of nature enlarges, we gradually learn to combine the presumptions arising from analogy, with other general principles by which they are limited and corrected. In comparing, for example, the anatomy of

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Their voluminous works are all lost: but they are quoted by Galen, almost in every page." . . .

"What Galen principally wanted was opportunities of dissecting human bodies, for his subject was most commonly some quadruped, whose structure was supposed to come nearest to the human." . . . .

"About the year 1540, the great Vesalius appeared. He was equally laborious in reading the ancients, and in dissecting bodies; and in making the comparison, he could not but see, that many of Galen's descriptions were erroneous.—The spirit of opposition and emulation was presently roused, and many of his contemporaries endeavoured to defend Galen, at the expense of Vesalius. In their disputes they made their appeals to the human body; and thus in a few years our art was greatly improved. And Vesalius being detected in the very fault which he condemns in Galen, to wit, describing from the dissections of brutes, and not of the human body, it exposed so fully that blunder of the older anatomists, that, in succeeding times, there has been little reason for such complaint."

Introductory Lectures, delivered by Dr. William Hunter to his last course of anatomy, (London, 1784.) pp. 13, 19, 25, 40.

different tribes of animals, we invariably find, that the differences in their structure have a reference to their way of life, and to the habits for which they are destined; so that, from knowing the latter, we might be able, on some occasions, to frame conjectures *a priori* concerning the former. It is thus, that the form of the teeth, together with the length and capacity of the intestines, vary in different species, according to the quality of the food on which the animal is to subsist. Similar remarks have been made on the different situation and disposition of the *mammæ*, according as the animal is uniparous, or produces many at a birth; on the structure and direction of the external ear, according as the animal is rapacious, or depends for security on his speed;—on the mechanism of the pupil of the eye, according as the animal has to search for his food by day or by night,—and on various other organs in the bodily economy, when compared with the functions which they are intended to perform. If, without attending to circumstances of this sort, a person should reason confidently from the anatomy of one species to that of another, it cannot be justly said, that analogy is a deceitful guide, but that he does not know how to apply analogy to its proper purpose. In truth, the very consideration which gives to the argument from analogy its chief force, points here manifestly to the necessity of some modification of the original conclusion, suited to the diversity of the case to which it is to be applied.

It is remarked by Cuvier, that "a canine tooth, adapted to tear flesh, was never found combined in the same animal with a hoof, fit for supporting the weight of the body, but totally useless as a weapon to a beast of prey." —"Hence, (he observes) the rule that every hoofed animal is herbivorous.—and hence, as corollaries from this general principle, the maxims, that a hoofed animal indicates grinding teeth with flat surfaces, a long alimentary canal, a large stomach, and often more stomachs than one, with many other similar consequences.

"The laws which regulate the relations between different systems of organs, (continues this very ingenious and sound philosopher,) have the same influence on the different parts of the same system, and connect together its different modifications, by the same necessary principles. In the alimentary system, especially, where the parts are large and numerous, these rules have their most striking applications. The form of the teeth, the length, the convolutions, the dilatations of the alimentary canal, the number and abundance of the gastric liquors, are in the most exact adaptation to one another, and have similar fixed relations to the chemical composition, to the solid aggregation, and to the solubility of the aliment; insomuch that, from seeing one of the parts by itself, an experienced observer could form conclusions tolerably accurate, with respect to the conformation of the other parts of the same system, and might even hazard more than random conjectures with respect to the organs of other functions.

"The same harmony subsists among the different parts of the system of organs of motion. As all the parts of this system act mutually, and are acted upon, especially when the whole body of the animal is in motion, the forms of all the different parts are strictly related. There is hardly a bone that can vary in its surfaces, in its curvatures, in its protuberances, without corresponding variations in other bones; and in this way, a skilful naturalist, from the appearance of a single bone, will be often able to conclude, to a certain extent, with respect to the form of the whole skeleton to which it belonged.

"These laws of co-existence (Cuvier adds) which have just been indicated, are deduced by reasoning from our knowledge of the reciprocal influence of the functions, and of the uses of the different organs of the body. Having confirmed them by observation, we are enabled, in other circumstances, to follow a contrary route; and, when we discover constant relations of form between particular organs, we may safely conclude, that they exercise some action upon one another; and we may thus be frequently led to form just conjectures with respect to their uses.—It is, indeed, chiefly from the attentive study of these relations, and from the discovery of relations which have hitherto escaped our notice, that physiology has reason to hope for the extension of her limits; and accordingly, the comparative anatomy of animals is to her one of the most fruitful sources of valuable discovery."*

The general result of these excellent observations is, that the improvement of physiology is to be expected chiefly from lights furnished by analogy; but that, in order to follow this guide with safety, a cautious and refined logic is still more necessary than in conducting those reasonings which rest on the direct evidence of experience. When the ancient anatomists, without any examination of the facts within their reach, or any consideration of the peculiar functions likely to be connected with man's erect form and rational faculties, drew inferences concerning his internal frame, merely from the structure of the quadrupeds; the errors into which they fell,—so far from affording any solid argument against the use of analogy when judiciously employed,—have only pointed out to their successors the necessity of a more discriminating and enlightened application of it in future; and have ultimately led to the discovery of those comprehensive Laws of the Animal Economy, which, by reconciling apparent anomalies with the consistency and harmony of *one grand design*, open, at every successive step of our progress, more enlarged and pleasing views of the beneficent wisdom of Nature.

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* See the Introduction to the *Leçons d'Anatomie comparée de G. Cuvier*. The above translation is taken from a very interesting tract, entitled, An Introduction to the Study of the Animal Economy. (Edinburgh, 1801.)

This speculation might be carried farther, by extending it to the various analogies which exist between the Animal and the Vegetable kingdoms, contrasted with those characteristical peculiarities by which they are respectively adapted to the purposes for which they are destined. It is, however, of more consequence, on the present occasion, to turn our attention to the analogies observable among many of the physical processes by which different effects are accomplished, or different phenomena produced, in the system of inanimate and unorganized matter. Of the existence of such analogies a satisfactory proof may be derived, from the acknowledged tendency of philosophical habits and scientific pursuits, to familiarize the mind with the order of nature, and to improve its penetration in anticipating future discoveries. A man conversant with physics and chemistry is much more likely than a stranger to these studies to form probable conjectures concerning those laws of nature which still remain to be examined. There is a certain character or *style* (if I may use the expression) in the operations of Divine Wisdom;—something which everywhere announces, amidst an infinite variety of detail, an inimitable unity and harmony of design; and in the perception of which *philosophical sagacity and genius* seem chiefly to consist. It is this which bestows a value so inestimable on the Queries of Newton.*

This view of the numberless analogies displayed in that part of the universe which falls under our immediate notice, becomes more particularly impressive, when it is considered, that the same unity of design may be distinctly traced, as far as the physical researches of astronomers have extended. In the knowledge of this fact, we possess important moral lights, for which we are entirely indebted to the Newtonian school; the universal creed of antiquity having assumed as a principle, that the celestial phenomena are, in their nature and laws, essentially different from the terrestrial. The Persian Magi, indeed, are said to have laid down as one of their maxims,—*συμπαθῆ ειναι τα ανω τοις κατω*;—but that no maxim could stand in more direct opposition to the tenets of the Grecian philosophers, appears sufficiently from the general strain of their physical and astronomical theories. The modern discoveries have shown, with demonstrative evidence, how widely, in this fundamental assumption, these philosophers erred from the truth; and, indeed, it was a conjecture *a priori*, originating in some degree of scepticism with respect to it, that led the way to the doctrine of gravitation. Every subsequent step which has been gained in astronomical science has tended more and more to illustrate the sagacity of those views by which Newton was guided to this fortunate anticipation of the truth; as well as to confirm, upon a scale which continually grows in its magnitude, the justness of that magnificent conception of uniform design, which emboldened him to connect the physics of the Earth with the hitherto unexplored mysteries of the Heavens.

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* How very deeply Newton's mind was impressed with those ideas of analogy which I have here ventured to ascribe to him, appears from his own words. "Have not the small particles of bodies certain powers, virtues, or forces, by which they act at a distance, not only upon the rays of light for reflecting, refracting, and inflecting them, but also upon one another, for producing a great part of the phenomena of nature? For it is well known that bodies act one upon another, by the attractions of gravity, magnetism, and electricity; *and these instances show the tenor and course of nature, and make it not improbable but that there may be more attractive powers than these. For nature is very consonant and conformable to herself.*" See the 31st Query, at the end of his Optics.

In a subsequent part of this Query, he recurs to the same principle. "And thus *Nature will be very conformable to herself and very simple;* performing all the great motions of the heavenly bodies by the attraction of gravity, which intercedes those bodies; and almost all the small ones of their particles, by some other attractive and repelling powers, which intercede the particles."

Instructive and interesting, however, as these physical speculations may be, it is still more pleasing to trace the uniformity of design which is displayed in the economy of sensitive beings; to compare the arts of human life with the instincts of the brutes, and the instincts of the different tribes of brutes with each other; and to remark, amidst the astonishing variety of means which are employed to accomplish the same ends, a certain analogy characterize them all;—or to observe, in the minds of different individuals of our own species, the workings of the same affections and passions, manifesting, among men of every age and of every country, the kindred features of humanity. It is this which gives the charm to what we call *Nature* in epic and dramatic composition,—when the poet speaks a language "to which every heart is an echo," and which, amidst the manifold effects of education and fashion, in modifying and disguising the principles of our constitution, reminds all the various classes of readers or of spectators, of the existence of those moral ties which unite them to each other, and to their common parent.*

Nor is it only in the material and moral worlds, when considered as separate and independent systems, that this unity of design is perceptible. They mutually bear to each other numberless *relations*, which are more particularly remarkable, when we consider both, in their combined tendencies with respect to human happiness and improvement. There is also a more general analogy, which these two grand departments of nature exhibit, in the *laws* by which their phenomena are regulated, and a consequent analogy between the methods of investigation peculiarly applicable to each. I have already repeatedly taken notice of the erroneous conclusions to which we are liable, when we reason directly from the one to the other; or substitute the fanciful analogies between them, which language occasionally suggests, as a philosophical explanation of the phenomena of either. But it does not follow from this, that there is no analogy between the rules of inquiry, according to which they are to be studied. On the contrary, it is from the principles of inductive philosophising, which are applicable to both in common, that we infer the necessity of resting our conclusions in each, upon its own appropriate phenomena.

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* Outlines of Moral Philosophy, pp. 198, 199. 3d Edit.

I shall only add, to what has been now stated on the head of analogy, that the numberless references and dependencies between the material and the moral worlds, exhibited within the narrow sphere of our observation on this globe, encourage and even authorize us to conclude, that they both form parts of one and the same plan ;—a conclusion congenial to the best and noblest principles of our nature, and which all the discoveries of genuine science unite in confirming. Nothing, indeed, could be more inconsistent with that irresistible disposition which prompts every philosophical inquirer to argue from the known to the unknown, than to suppose that, while all the different bodies which compose the *material* universe are manifestly related to each other, as parts of a connected *whole*, the *moral* events which happen on our planet are quite insulated ; and that the rational beings who inhabit it, and for whom we may reasonably presume it was brought into existence, have no relation whatever to other intelligent and moral natures. The presumption unquestionably is, that there is one great *moral system*, corresponding to the *material system :* and that the connexions which we at present trace so distinctly among the sensible objects composing the one, are exhibited as so many intimations of some vast scheme, comprehending all the intelligent beings who compose the other. In this argument, as well as in numberless others, which analogy suggests in favour of our future prospects, the evidence is precisely of the same sort with that which first encouraged Newton to extend his physical speculations beyond the limits of the Earth. The sole difference is, that he had an opportunity of verifying the results of his conjectures by an appeal to sensible facts: but this accidental circumstance (although it certainly affords peculiar satisfaction and conviction to the astronomer's mind) does not affect the grounds on which the conjecture was *originally* formed, and only furnishes an experimental proof of the justness of the principles on which it proceeded. Were it not, however, for the palpable confirmation thus obtained of the Theory of Gravity, it would be difficult to vindicate against the charge of presumption, the mathematical accuracy with which the Newtonians pretend to compute the motions, distances, and magnitudes of worlds, apparently so far removed beyond the examination of our faculties.*

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* "I know no author (says Dr. Reid) who has made a more just and a more happy use of analogical reasoning, than Bishop Butler, in his analogy of Religion, Natural and Revealed, to the Constitution and Course of Nature. In that excellent work, the author does not ground any of the truths of religion upon Analogy, as their proper evidence. He only makes use of Analogy to answer objections against them. When objections are made against the truths of religion, which may be made with equal strength against what we know to be true in the course of nature, such objections can have no weight." (Essays on the Intell. Powers, p. 54.)

To the same purpose it is observed by Dr. Campbell, that "analogical evidence is generally more successful in silencing objections than in evincing truth. Though it rarely refutes, it frequently repels refutation; like those weapons which, though they cannot kill the enemy, will ward his blows." (Phil. of Rhet. Vol. I. p. 145.)

This estimate of the force of analogical reasoning, considered as a weapon of controversy, is discriminating and judicious. The occasion on which the logician wields it to the best advantage is, undoubtedly, in repelling the objections of an adversary. But after the foregoing observations, I may be permitted to express my doubts, whether both of these ingenious writers have not somewhat underrated the importance of analogy as a medium of proof, and as a source of new information.—I acknowledge, at the same time, that between the positive and the negative applications of this species

The foregoing observations have a close connexion with some reasonings hereafter to be offered in defence of the doctrine of *final causes*. They also throw additional light on what was remarked in a former chapter concerning *the unity of truth* :—a most important fact in the theory of the human mind, and a fact which must strike every candid inquirer with increasing evidence, in proportion to the progress which he makes in the *interpretation of Nature*. Hence the effect of philosophical habits in animating the curiosity, and in guiding the inventive powers; and hence the growing confidence which they inspire in the ever-consistent and harmonious conclusions of inductive science. It is chiefly (as Bacon has observed) from partial and desultory researches that scepticism arises; not only as such researches suggest doubts which a more enlarged acquaintance with the universe would dispel, but as they withdraw the attention from those comprehensive views which combine into a symmetrical fabric—all whose parts mutually lend to each other support and stability—the most remote, and seemingly the most unconnected discoveries. "*Etenim symmetria scientiæ, singulis scilicet partibus se invicem sustinentibus*, est, et esse debet, vera atque expedita ratio refellendi objectiones minorum gentium: Contra, si singula axiomata, tanquam baculos fascis seorsim extrahas, facile erit ea infirmare, et pro libito, aut flectere aut frangere. Num non in aula spatiosa consultius

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of evidence, there is an essential difference. When employed to refute an objection, it may often furnish an argument irresistibly and unanswerably convincing: when employed as a medium of proof, it can never authorize more than a probable conjecture, inviting and encouraging farther examination. In some instances, however, the probability resulting from a concurrence of different analogies may rise so high, as to produce an effect on the belief scarcely distinguishable from moral certainty.

foret, unum accendere cereum, aut lychnuchum suspendere, variis luminibus instructum, quo omnia simul perlustrentur, quam in singulos angulos quaquaversus exiguam circumferre lucernam?"*

II.

Use and Abuse of Hypotheses in Philosophical Inquiries. Difference between Gratuitous Hypotheses, and those which are supported by presumptions suggested by Analogy.—Indirect Evidence which a Hypothesis may derive from its agreement with the Phenomena.—Cautions against extending some of these conclusions to the Philosophy of the Human Mind.

As some of the reasonings in the former part of this Section may, at first sight, appear more favourable to the use of Hypotheses than is consistent with the severe rules of the Inductive Logic, it may not be superfluous to guard against any such misapprehensions of my meaning, by subjoining a few miscellaneous remarks and illustrations.

The indiscriminate zeal against hypotheses, so generally avowed at present by the professed followers of Bacon, has been much encouraged by the strong and decided terms in which, on various occasions, they are reprobated by Newton.* But the language of this great man, when he happens to touch upon logical questions, must not always be too literally interpreted. It must be qualified and limited, so as to accord with the exemplifications which he himself has given of his general rules. Of the truth of this remark, the passages now alluded to afford a satisfactory proof; for, while they are expressed in the most unconditional and absolute terms, so many exceptions to them occur in his own writings, as to authorize the conclusion, that he expected his readers would of themselves be able to supply the obvious and necessary comments. It is probable that, in these passages, he had more particularly in his eye the Vortices of Des Cartes.

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* De Augment. Scient. Lib. i.

"The votaries of hypotheses (says Dr. Reid) have often been challenged to show one useful discovery in the works of nature that was ever made in that way."† In reply to this challenge, it is sufficient, on the present occasion, to mention the theory of Gravitation, and the

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* "Hypotheses non fingo. Quicquid enim ex phenomenis non deducitur hypothesis vocanda est, et hypotheses, seu metaphysicæ, seu physicæ, seu qualitatum occultarum, seu mechanicæ, in philosophia experimentali locum non habent. See the general *Scholium* at the end of the *Principia*.

† Essays on the Intellectual Powers of Man, p. 88. 4to Edit. In another part of the same volume, the following assertion occurs. "Of all the discoveries that have been made concerning the inward structure of the human body, never one was made by conjecture.—The same thing may be said, with justice, of every other part of the works of God, wherein any real discovery has been made. Such discoveries have always been made by patient observation, by accurate experiments, or by conclusions drawn by strict reasoning from observations and experiments; and such discoveries have always tended to refute, but not to confirm, the theories and hypotheses which ingenious men had invented." Ibid. p. 49.

Copernican system.* Of the former we have the testimony of Dr. Pemberton, that it took its first rise from a conjecture or hypothesis suggested by *analogy;* nor indeed could it be considered in any other light, till that period in Newton's life, when, by a calculation founded on the accurate measurement of the earth by Picard, he evinced the coincidence between the law which regulates the fall of heavy bodies, and the power which retains the Moon in her orbit. The Copernican system, however, furnishes a case still stronger, and still more directly applicable to our purpose; inasmuch as the only evidence which the author was able to offer in its favour, was the advantage which it possessed over every other hypothesis, in explaining, with simplicity and beauty, all the phenomena of the heavens. In the mind of Copernicus, therefore, this system was nothing more than a hypothesis;—but it was a hypothesis conformable to the universal *analogy* of nature, always accomplishing her ends by the simplest means. "C'est pour *la simplicité* (says Bailly) que Copernic replaca le soleil au centre du monde; c'est pour elle que Kepler va détruire tous les épicycles que Copernic avoit laissés subsister: peu de principes, de grands moyens en petit nombre, des phénomènes infinis et variés, voilà le tableau de l'univers."†

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* See Note (R.)

† Histoire de l'Astronomie Moderne, Tome II. p. 2.

From this anticipation of simplicity in the laws of nature, (a logical principle not less universally recognized among ancient than among modern philosophers,) Bailly has drawn an argument in support of his favourite hypothesis concerning the origin of the sciences. His words are these, "La simplicité n'est pas essentiellement un principe, un axiôme, c'est le résultat des travaux; ce n'est pas une idée de l'enfance du monde, elle

According to this view of the subject, the confidence which we repose in Analogy rests ultimately on the evidence of Experience; and hence, an additional argument in favour of the former method of investigation, when cautiously followed; as well as an additional proof of the imperceptible shades by which Experience and Analogy run into each other.

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appartient à la maturité des hommes; c'est la plus grande des vérités que l'observation constante arrache à l'illusion des effets: ce ne peut-être qu'un reste de la science primitive. Lorsque chez un peuple, possesseur d'une mythologie compliquée, et qui n'a d'autre physique que ces fables, les philosophes, voulant réduire la nature à un seul principe, annonceront que l'eau est la source de toutes choses, ou le feu l'agent universel, nous dirons à ces philosophes: vous parlez une langue que n'est pas la vôtre; vous avez saisi par un instinct philosophique ces vérités au-dessus de votre siècle, de votre nation, et de vous-mêmes; c'est la sagesse des anciens qui vous a été transmise par tradition," &c. &c. &c.—Ibid. p. 4.

[To the general remark which introduces this passage, I readily subscribe. The confidence with which philosophers anticipate the simplicity of Nature's laws, is unquestionably the result of experience, and of experience alone; and implies a far more extensive knowledge of her operations than can be expected from the uninformed multitude. The inference, however, deduced from this, by the ingenious and eloquent, but sometimes too fanciful historian, is not a little precipitate. The passion for excessive simplification, so remarkably exemplified in the physical systems of the Greeks, seems to be sufficiently accounted for by their scanty stock of facts, combined with that ambition to explain every thing from the smallest possible number of data, which, in all ages of the world, has been one of the most common infirmities of genius. On the other hand, the principle in question, when stated in the form of a proposition, is of so abstract and metaphysical a nature, that it is highly improbable it should have survived the shock of revolutions which had proved fatal to the memory of particular discoveries. The arts, it has been frequently observed, are more easily transmitted by mere tradition, from one generation to another, than the speculative sciences; and, for a similar reason, physical systems are far less likely to sink into oblivion, than abstract maxims, which have no immediate reference to objects of sense, or to the ordinary concerns of life.

Nor is the utility of hypothetical theories confined to those cases in which they have been confirmed by subsequent researches: it may be equally great, where they have completely disappointed the expectations of their authors. Nothing, I think, can be juster than Hartley's remark, that any hypothesis which possesses a sufficient degree of plausibility to account for a number of facts, helps us to digest these facts in proper order, to bring new ones to light, and to make *experimenta crucis* for the sake of future inquirers."* Indeed, it has probably been in this way that most discoveries have been made; for although a knowledge of facts must be prior to the formation of a legitimate theory; yet a hypothetical theory is generally the best guide to the knowledge of connected and of useful facts.

The first conception of a hypothetical theory, it must always be remembered, (if the theory possesses any plausibility whatever) presupposes a general acquaintance with the phenomena which it aims to account for; and it is by reasoning synthetically from the hypothesis, and comparing the deductions with observation and experiment, that the cautious inquirer is gradually led, either to correct it in such a manner as to reconcile it with facts, or finally to abandon it as an unfounded conjecture. Even in this latter case, an approach is made to the truth in the way of *exclusion;* while, at the same time, an accession is gained to that class of associated and kindred phenomena, which it is his object to trace to their parent stock.†

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* Observations on Man, Chap. i. Prop. v.

† Illud interim monemus; ut nemo animo concidat, aut quasi confundatur, si experimenta, quibus incumbit, expectationi suæ non respondent.

In thus apologizing for the use of hypotheses, I only repeat in a different form the precepts of Bacon, and the comments of some of his most enlightened followers. "The prejudice against hypotheses which many people entertain, (says the late Dr. Gregory) is founded on the equivocal signification of a word. It is commonly confounded with theory :—but a hypothesis properly means the supposition of a principle, of whose existence there is no proof from experience, but which may be rendered more or less probable by facts which are neither numerous enough, nor adequate to infer its existence. When such hypotheses are proposed in the modest and diffident manner that becomes mere suppositions or conjectures, they are not only harmless, but even necessary for establishing a just theory. *They are the first rudiments or anticipations of Principles.* Without these, there could not be useful observation, nor experiment, nor arrangement, because there could be no motive or principle in the mind to form them. Hypotheses then only become dangerous and censurable, when they are imposed on us for just principles ; because, in that case, they put a stop to further inquiry, by leading the mind to acquiesce in principles which may as probably be ill as well founded."*

Another eminent writer has apologized very ingeniously, and I think very philosophically, for the hypotheses and

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Etenim quod succedit, magis complaceat; at quod non succedit, sæpenumero non minus informat. Atque illud semper in animo tenendum, *experimenta lucifera* etiam adhuc magis, quam fructifera ambienda esse. Atque de *literata experientia* hæc dicta sint; quæ *sagacitas* potius est, et odoratio quædam venatica, quam *scientia*." De Augm. Scient. Lib. v. Cap. ii.

* Lectures on the Duties and the Qualifications of a Physician.

conjectures which are occasionally to be found in his own works. The author I mean is Dr. Stephen Hales, who, in the preface to the second volume of his Vegetable Statics, has expressed himself thus :

"In natural philosophy we cannot depend on any mere speculations of the mind ; we can only reason with any tolerable certainty from proper data, such as arise from the united testimony of many good and credible experiments.

"Yet it seems not unreasonable, on the other hand, though not far to indulge, to carry our reasonings a little farther than the plain evidence of experiments will warrant; for since at the utmost boundaries of those things which we clearly know, a kind of twilight is cast on the adjoining borders of *Terra Incognita*, it seems reasonable, in some degree, to indulge conjecture *there;* otherwise we should make but very slow advances, either by experiments or reasoning. For new experiments and discoveries usually owe their first rise only to lucky guesses and probable conjectures ; and even disappointments in these conjectures often lead to the things sought for."

To these quotations I shall add two short extracts from Dr. Hooke, (the contemporary, or rather the predecessor of Newton,) whose acute and original remarks on this subject reflect the greater credit on his talents, that they were published at a period, when the learned body of which he was so illustrious an ornament, seem plainly to have been more disposed to follow the letter of some detached sentences, than to imbibe the general spirit of Bacon's logic.

"There may be use of method in the collecting of materials, as well as in the employment of them; for there ought to be some end and aim; some predesigned module and theory; some purpose in our experiments. And though this Society have hitherto seemed to avoid and prohibit preconceived theories and deductions from particular and seemingly accidental experiments; yet I humbly conceive, that such, if knowingly and judiciously made, are matters of the greatest importance; as giving a characteristic of the aim, use, and signification thereof; and without which many, and possibly the most considerable particulars, are passed over without regard and observation.*

"Where the *data* on which our ratiocinations are founded are uncertain and only conjectural, the conclusions or deductions therefrom can at best be no other than probable, but still they become more and more probable, as the consequences deduced from them appear, upon examinations by trials and designed observations, to be confirmed by fact or effect. So that the effect is that which consummates the demonstration of the invention; and the theory is only an assistant to direct such an inquisition, as may procure the demonstration of its existence or nonexistence."†

As an illustration of this last remark, Hooke mentions his anticipation of Jupiter's motion upon his axis, long before he was able, by means of a good tellescope, to ascertain the fact. A much more remarkable instance, however, of his philosophical sagacity occurs in his anticipation of that theory of the planetary motions, which, soon after, was to present itself, with increased and at length demonstrative evidence, to a still more inventive and powerful mind. This conjecture (which I shall state in his own words) affords, of itself, a decisive reply to the undistinguishing censures which have so often been bestowed on the presumptuous vanity of attempting, by means of hypotheses, to penetrate into the secrets of nature.

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* Hooke's Posthumous Works, p. 280.

† Ibid. p. 587. For another extract from the same work, See Note (S.)

"I will explain (says Hooke, in a communication to the Royal Society in 1666) a system of the world very different from any yet received. It is founded on the three following positions.

"1. That all the heavenly bodies have not only a gravitation of their parts to their own proper centre, but that they also mutually attract each other within their spheres of action.

"2. That all bodies having a simple motion, will continue to move in a straight line, unless continually deflected from it by some extraneous force, causing them to describe a circle, an ellipse, or some other curve.

"3. That this attraction is so much the greater as the bodies are nearer. As to the proportion in which those forces diminish by an increase of distance, I own I have not discovered it, although I have made some experiments to this purpose. I leave this to others, who have time and knowledge sufficient for the task."

The argument in favour of Hypotheses might be pushed much farther, by considering the tentative or *hypothetical* steps by which the most cautious philosophers are often under the necessity of proceeding, in conducting inquiries strictly experimental. These cannot be better described than in the words of Boscovich, the slightest of whose logical hints are entitled to peculiar attention.—"In some instances, observations and experiments at once reveal to us all that we wish to know. In other cases, we avail ourselves of the aid of *hypotheses;—by which word, however, is to be understood, not fictions altogether arbitrary, but suppositions conformable to experience or to analogy.* By means of these, we are enabled to supply the defects of our *data,* and to conjecture or divine the path to truth; always ready to abandon our hypothesis, when found to involve consequences inconsistent with fact. And indeed, in most cases, I conceive this to be the method best adapted to physics; a science in which the procedure of the inquirer may be compared to that of a person attempting to decipher a letter written in a secret character; and in which, legitimate theories are generally the slow result of disappointed essays, and of errors which have led the way to their own detection."*

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* De Solis ac Lunæ Defectibus. Lond. 1760. pp. 211, 212. (For the continuation of the above passage, See Note (T.)

Many remarks to the same purpose may be found in Bacon. The following happen at present to occur to my memory.

" Deo (*formarum* inditori et opifici) et fortasse angelis competit, formas per affirmationem immediate nosse, atque ab initio contemplationis. Sed certe supra hominem est; cui tantum conceditur, procedere primo per *negativas*, et postremo loco desinere in *affirmativas*, post omnimodam exclusionem. . . . . . Post *rejectionem* et *exclusionem* debitis modis factam, secundo loco (tanquam in fundo) manebit (abeuntibus in fumum opinionibus

Nor is it solely by the erroneous results of his own hypotheses, that the philosopher is assisted in the investigation of truth. Similar lights are often to be collected from the errors of his predecessors; and hence it is, that accurate histories of the different sciences may justly be ranked among the most effectual means of accelerating their future advancement. It was from a review of the endless and hopeless wanderings of preceding inquirers, that Bacon inferred the necessity of avoiding every beaten tract; and it was this which encouraged him,—with a

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volatilibus) *forma* affirmativa, solida, et vera. Atque hoc brevi dictu est, sed per multas ambages ad hoc pervenitur." (Nov. Org. Lib. II. Aphor. XV. XVI.)

"Prudens *interrogatio*, quasi dimidium scientiæ. Idcirco quo amplior et certior fuerit anticipatio nostra; eo magis directa et compendiosa erit investigatio." (De Aug. Scient. Lib. V. Cap. 3.)

"Vaga experientia et se tantum sequens mera palpatio est, et homines potius stupefacit, quam informat." (Nov. Org. Lib. I. Aphor. C.)

The reader who wishes to prosecute farther this speculation concerning the use of hypotheses, may consult with advantage three short but interesting memoirs upon Method, by the late M. Le Sage of Geneva, which M. Prévost has annexed as a supplement to his *Essais de Philosophie.* That I may not be supposed, however, to acquiesce in *all* this author's views, I shall mention two strong objections to which some of them appear to me to be liable.

1. In treating of the method of Hypothesis, Le Sage uniformly contrasts it with that of Analogy, as if the two were radically distinct, and even opposite in their spirit; whereas it seems evident, that some perception of analogy must have given birth to every hypothesis which possesses a sufficient degree of plausibility to deserve farther examination.

2. In applying the rules of mathematical Method to Physics, he makes far too little allowance for the essential difference between the two sciences. This is more particularly remarkable in his observations on the aid to be derived, in investigating the laws of nature, from *the method of Exclusions*,—so happily employed by Frenicle de Bessy (a French mathematician of the 17th century) in the solution of some very difficult problems relating to numbers.—See Note (U.)

confidence in his own powers amply justified by the event —to explore and to open a new path to the mysteries of nature: *Inveniam viam, aut faciam.* In this respect, the maturity of reason in the *species* is analogous to that in the *individual;* not the consequence of any sudden or accidental cause, but the fruit of reiterated disappointments correcting the mistakes of youth and inexperience. "There is no subject (says Fontenelle) on which men ever come to form a reasonable opinion, till they have once exhausted all the absurd views which it is possible to take of it. What follies (he adds) should we not be repeating at this day, if we had not been anticipated in so many of them by the ancient philosophers!" Those systems, therefore, which are false, are by no means to be regarded as altogether useless. That of Ptolemy (for example) as Bailly has well observed, is founded on a prejudice so natural and so unavoidable, that it may be considered as a necessary step in the progress of astronomical science; and if it had not been proposed in ancient times, it would infallibly have preceded, among the moderns, the system of Copernicus, and retarded the period of its discovery.

In what I have hitherto said in defence of the method of Hypothesis, I have confined myself entirely to its utility as an organ of investigation; taking all along for granted, that, till the principle assumed has been fairly inferred as a law of nature, from undoubted facts, none of the explanations which it affords are to be admitted as legitimate theories. Some of the advocates for this method have however gone much farther; asserting, that if a hypothesis be sufficient to account for all the phenomena in question, no other proof of its conformity to truth is necessary. "Supposing (says Dr. Hartley) the existence of *the æther* to be destitute of all direct evidence, still, if it serves to explain and account for a great variety of phenomena, it will, by this means, have an indirect argument in its favour. Thus, we admit the key of a cipher to be a true one, when it explains the cipher completely; and the decipherer judges himself to approach to the true key in proportion as he advances in the explanation of the cipher; and *this* without any direct evidence at all."* On another occasion, he observes, that "Philosophy is the art of *deciphering* the mysteries of nature; and that every theory which can explain all the phenomena, has the same evidence in its favour, that it is possible the key of a cipher can have from its explaining that cipher."†

The same very ingenious and plausible reasoning is urged by Le Sage in one of his posthumous fragments;‡ and, long before the publication of Hartley's work, it had struck Gravesande so strongly, that, in his *Introductio ad Philosophiam*, he has subjoined to his chapter on the Use of Hypotheses, another on the Art of Deciphering.

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* Observations on Man, Vol. I. pp. 15, 16. (4th Edit.)

† Ibid. p. 350. The section from which this quotation is taken (entitled "Of Propositions and the nature of Assent") contains various ingenious and just observations, blended with others strongly marked with the author's peculiar turn of thinking. Among these last may be mentioned his Theory of Mathematical Evidence, coinciding exactly with that which has since been proposed by Dr. Beddoes. Compare Hartley with pp. 181. and 182. of this volume.

‡ "N'admettons-nous pas pour vraie, la clef d'une lettre écrite en chiffres, ou celle d'une logogryphe; quand cette clef s'applique exactement à tous les caracteres dont il faut rendre raison?" Opuscules de G. L. Le Sage, relatifs a la Methode. See M. Prévost's Essais de Philosophie.

Of the merit of the latter it is no slight proof, that D'Alembert has inserted the substance of it in one of the articles of the *Encyclopedie.**

In reply to Hartley's comparison between the business of the philosopher and that of the decipherer, Dr. Reid observes, that "to find the key requires an understanding equal or superior to that which made the cipher. This instance, therefore, (he adds) will *then* be in point, when he who attempts to decipher the works of nature by a hypothesis, has an understanding equal or superior to that which made them."

This argument is not stated with the author's usual correctness in point of logic; inasmuch as the first proposition contrasts the sagacity of the decipherer with that of the contriver of the *cipher;* and the second, with that of the author of the *composition* deciphered. Nor is this all. The argument proceeds on the supposition, that, if the task of the scientific inquirer be compared to that of the decipherer, the views of the author of nature may, with equal propriety, be compared to those of the inventor of the cipher. It is impossible to imagine that this was Hartley's idea. The object of true philosophy is, in no case, presumptuously to divine an alphabet of *secret* characters or ciphers, purposely employed by infinite Wisdom to *conceal* its operations; but, by the diligent study of facts and analogies legible to all, to discover the key which infinite Wisdom has itself prepared for the interpretation of its own laws. In other words, its object is, to concentrate and to cast on the unknown parts of the universe, the lights which are reflected from those which are known.

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* Article *Déchiffrer*. See also D'Alembert's Oeuvres Posthumes. Tome II. p. 177.—Gravesande's Logic was published in 1736.

† Essays on the Intell. Powers, p. 88.

In this instance, as well as in others, where Reid reprobates hypotheses, his reasoning uniformly takes for granted, that they are wholly arbitrary and gratuitous. "If a thousand of the greatest wits (says he) that ever the world produced, were, *without any previous knowledge in anatomy,* to sit down and contrive how, and by what internal organs, the various functions of the human body are carried on—how the blood is made to circulate, and the limbs to move—they would not, in a thousand years, hit upon any thing like the truth."* Nothing can be juster than this remark; but does it authorize the conclusion, that, to an experienced and skilful anatomist, conjectures founded on analogy, and on the consideration of *uses,* are of no avail as media of discovery? The logical inference, indeed, from Dr. Reid's own statement, is, not against anatomical conjectures in general, but against the anatomical conjectures of those who are ignorant of anatomy.

The same reply may be made to the following assertion of D'Alembert; another writer, who, in my opinion, has, on various occasions, spoken much too lightly of analogical conjectures. "It may be safely affirmed, that a mere theorist (*un Physicien de Cabinet*) who, by means of reasonings and calculations, should attempt to divine the phenomena of nature, and who should afterwards compare his anticipations with facts, would be astonished to find how wide of the truth almost all of them had been."* If this observation be confined to those system-builders, who, without any knowledge of facts, have presumed to form conclusions *a priori* concerning the universe, its truth is so obvious and indisputable, that it was hardly worth the while of this profound philosopher so formally to announce it. If extended to such men as Copernicus, Kepler, and Newton, and to the illustrious train who have issued from the Newtonian school, it is contradicted by numberless examples, of which D'Alembert could not fail to be perfectly aware.†

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* Ibid. p. 49.

The sagacity which guides the Philosopher in conjecturing the laws of nature, has, in its metaphysical origin, a very near affinity to that *acquired perception* of human character, which is possessed by Men of the World. The conclusions of one individual with respect to the springs of action in the breast of another, can never, on the most favourable supposition, amount to more than to a Hypothesis supported by strong analogies; yet how different is the value of the Hypothesis, according to the intellectual habits of him by whom it is formed! What more absurd and presumptuous than the theories of the cloistered schoolman concerning the moral or the political phenomena of active life! What more interesting and instructive than the slightest characteristical sketches from the hand of a Sully or of a Clarendon!

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* Mélanges de Litterature, &c. Tome V. § 6. (entitled Eclaircissement sur ce qui a été dit, &c. de l'art de conjecturer.)

† Accordingly, in another part of the same article, he has said: " L'analogie, c'est-a-dire, la ressemblance plus ou moins grande des faits, le rapport plus ou moins sensible qu'ils ont entr'eux, est l'unique regle des physiciens, soit pour expliquer les faits connus, soit pour en découvrir de nouveaux."

To these suggestions in vindication of hypotheses it may be added, that some of the reasonings which, with propriety, were urged against them a century ago, have already, in consequence of the rapid progress of knowledge, lost much of their force. It is very justly remarked by M. Prévost, that "at a period when science has advanced so far as to have accumulated an immense treasure of facts, the danger of hypotheses is less, and their advantages greater, than in times of comparative ignorance." For this he assigns three reasons. "1. The multitude of facts restrains Imagination, by presenting, in every direction, obstacles to her wanderings; and, by overturning her frail edifices. 2. In proportion as facts multiply, the memory stands in greater need of the aid of connecting or associating principles.* 3. The chance of discovering interesting and luminous relations among the objects of our knowledge increases with the growing number of the objects compared."†—The considerations already stated suggest a 4th reason in confirmation of the same general proposition:—That, by the *extension* of human knowledge, the scale upon which the Analogies of Nature may be studied, is so augmented as to strike the most heedless eye; while, by its *diffusion*, the perception of these analogies (so essential an element in the composition of inventive genius) is insensibly communicated to all who enjoy the advantages of a liberal education. Justly, therefore, might Bacon say, "Certo sciant homines, artes inveniendi solidas et veras adolescere et incrementa sumere cum ipsis inventis."

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* With respect to the utility of hypothetical theories, as *adminicles* to the natural powers of memory, see the former volume of this work, Chap. vi. Sections 3 and 4.

† See Note (X.)

But although I do not think that Reid has been successful in his attempt to refute Hartley's argument, I am far from considering that argument as sound or conclusive. My chief objections to it are the two following.

1. The cases compared are by no means parallel. In that of the *cipher*, we have *all* the facts before us; and if the key explains them, we may be certain, that nothing can directly contradict the justness of our interpretation. In *our physical researches*, on the other hand, we are admitted to see only a few detached sentences extracted from a volume, of the size of which we are entirely ignorant. No hypotheses, therefore, how numerous soever the facts may be with which it tallies, can completely exclude the possibility of exceptions or limitations hitherto undiscovered.

It must, at the same time, be granted, that the probability of a hypothesis increases in proportion to the number of phenomena for which it accounts, *and to the simplicity of the theory by which it explains them*;—and that, in some instances, this probability may amount to a moral certainty. The most remarkable example of this which occurs in the history of science is, undoubtedly, the Copernican system. I before observed, that at the period when it was first proposed, it was nothing more than a hypothesis; and that its only proof rested on its conformity, in point of simplicity, to the general economy of the Universe. "When Copernicus (says Mr. Maclaurin) considered the form, disposition, and motions of the system, as they were then represented after Ptolemy, he found the whole void of order, symmetry, and proposition; like a piece (as he expresses himself) made up of parts copied from different originals, which, not fitting each other, should rather represent a monster than a man. He therefore perused the writings of the ancient philosophers, to see whether any more rational account had ever been proposed of the motions of the Heavens. The first hint he had was from Cicero, who tells us, in his Academical Questions, that Nicetas, a Syracusian, had taught that the earth turns round on its axis, which made the whole heavens appear to a spectator on the earth to turn round it daily. Afterwards, from Plutarch he found that Philolaus the Pythagorean had taught that the earth moved annually round the sun. He immediately perceived, that, by allowing these two motions, all the perplexity, disorder, and confusion he had complained of in the celestial motions vanished; and that, instead of these, a simple regular disposition of the orbits, and a harmony of the motions appeared, worthy of the great author of the world.*

Of the truth of this hypothesis, the discoveries of the last century have afforded many new proofs of a direct and even demonstrative nature; and yet, it may be fairly questioned, whether to Copernicus and Galileo, the analogical reasoning stated in the preceding quotation, did not, of itself, appear so conclusive, as to supersede the necessity of any farther evidence. The ecclesiastical persecutions which the latter encountered in defence of his supposed heresy, sufficiently evinces the faith which he reposed in his astronomical creed.

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* Account of Newton's Philosophical Discoveries, p. 45. (2d Edit.)

This presumptive argument, as it presented itself to the mind of Copernicus, is thus stated by Bailly. "Les hommes sentent que la nature est simple; les stations et les rétrogradations des planetes offroient des apparences bizarres; le principe, qui les ramenoit à une marche simple, et naturelle, *ne pouroit étre qu'une vérité.*" Hist. de l'Astron. Mod. Tom. I. p. 351.

It is, however, extremely worthy of remark, with respect to the Copernican system, that it affords no illustration whatever of the justness of Hartley's logical maxim. The Ptolemaic system was not demonstrably *inconsistent* with any phenomena known in the sixteenth century: and, consequently, the presumption for the new hypothesis did not arise from its exclusive coincidence with the facts, but from the simplicity and beauty which it possessed as a theory. The inference to be deduced from it is, therefore, *not* in favour of hypotheses in general, but of hypotheses sanctioned by analogy.

The fortunate hypothesis of a Ring encircling the body of Saturn, by which Huyghens accounted, in a manner equally simple and satisfactory, for a set of appearances which, for forty years, had puzzled all the astronomers of Europe, bears, in all its circumstances, a closer resemblance than any other instance I know of, to the key of a cipher. Of its *truth* it is impossible for the most sceptical mind to entertain any doubt, when it is considered, that it not only enabled Huyghens to explain all the *known* phenomena, but to predict those which were afterwards to be observed. This instance, accordingly, has had much stress laid upon it by different writers, particularly by Gravesande and Le Sage."* I must own, I am somewhat doubtful, if the discovery of a key to so limited and insulated a class of optical facts, authorizes any valid argument for the employment of mere hypotheses, to decipher the complicated phenomena resulting from the general laws of nature. It is, indeed, an example most ingeniously and happily selected: but would not perhaps have been so often resorted to, if it had been easy to find others of a similar description.

2. The chief objection, however, to Hartley's comparison of the theorist to the decipherer is, that there are few, if any, physical hypotheses, which afford the *only* way of explaining the phenomena to which they are applied; and therefore, admitting them to be perfectly consistent with all the known facts, they leave us in the same state of uncertainty, in which the decipherer would find himself, if he should discover a variety of keys to the same cipher. Des Cartes acknowledges, that the same effect might, upon the principles of his philosophy, admit of manifold explanations; and that nothing perplexed him more than to know which he ought to adopt, in preference to the others. "The powers of nature, (says he) I must confess, are so ample, that no sooner do I observe any particular effect, than I immediately perceive that it may be deduced from *my* principles, in a variety of different ways; and nothing, in general, appears to me more diffi-

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* Gravesande, Introd. ad. Philosoph. §§ 979 945.

Opuscules de le Sage, published by M. Prévost. Premier Mémoire, § 25. The latter writer mentions the theory in question, as a hypothesis which received no countenance whatever from the analogy of any preceding astronomical discovery.

cult, than to ascertain by which of these processes it is really produced."* The same remark may, (with a very few exceptions) be extended to every hypothetical theory which is unsupported by any collateral probabilities arising from experience or analogy; and it sufficiently shows, how infinitely inferior such theories are, in point of evidence, to the conclusions obtained by the art of the decipherer. The principles, indeed, on which this last art proceeds, may be safely pronounced to be nearly infallible.

In these strictures upon Hartley, I have endeavoured to do as much justice as possible to his general argument, by keeping entirely out of sight the particular purpose which it was intended to serve. By confining too much his attention to this, Dr. Reid has been led to carry, farther than was necessary or reasonable, an indiscriminate zeal against every speculation to which the epithet *hypothetical* can in any degree be applied. He has been also led to overlook the essential distinction between hypothetical inferences from one department of the Material World to another, and hypothetical inferences from the Material World to the Intellectual. It was with the view of apologizing for inferences of the latter description, that Hartley advanced the logical principle which gave occasion to the foregoing discussion; and therefore, I apprehend, the proper answer to his argument is this :—Granting your principle to be true in all its extent, it furnishes no apology whatever for the Theory of Vibrations. If the science of mind admit of any illustration from the aid of hypotheses, it must be from such hypotheses alone as are consonant to *the analogy of its own laws.* To assume, as a fact, the existence of analogies between these laws and those of matter, is to sanction that very prejudice which it is the great object of the inductive science of mind to eradicate.

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* Dissertatio de Methodo. In the sentence immediately following, Des Cartes mentions the general rule which he followed, when such an embarrassment occurred. "Hinc aliter me extricare non possum, quàm si rursus aliqua experimenta quæram; quæ talia sint, ut eorum idem non sit futurus eventus, si hoc modo quam si illo explicetur." The rule is excellent; and it is only to be regretted, that so few exemplifications of it are to be found in his writings.

I have repeatedly had occasion, in some of my former publications, to observe, that the names of almost all our mental powers and operations are borrowed from sensible images. Of this number are intuition; the discursive faculty; attention; reflection; conception; imagination; apprehension; comprehension; abstraction; invention; capacity; penetration; acuteness. The case is precisely similar with the following terms and phrases, relative to a different class of mental phenomena;—inclination; aversion; deliberation; pondering; weighing the *motives* of our actions; yielding to that *motive* which is the strongest; —expressions (it may be remarked in passing,) which, when employed, without a very careful analysis of their import, in the discussion concerning the liberty of the will, gratuitously prejudge the very point in dispute; and give the semblance of demonstration, to what is, in fact, only a series of identical propositions, or a sophistical circle of words.*

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* "Nothing (says Berkeley) seems more to have contributed towards engaging men in controversies and mistakes with regard to the nature and operations of the mind, than the being used to speak of those things in terms borrowed from sensible ideas. For example, the will is termed the

That to the apprehensions of uneducated men such metaphorical or analogical expressions should present *the images* and *the things typified*, inseparably combined and blended together, is not wonderful; but it is the business of the philosopher to conquer these casual associations, and, by *varying* his metaphors, when he cannot completely lay them aside, to accustom himself to view the phenomena of thought in that naked and undisguised state in which they unveil themselves to the powers of consciousness and reflection. To have recourse therefore to the analogies suggested by popular language, for the purpose of *explaining* the operations of the mind, instead of advancing knowledge, is to confirm and to extend the influence of vulgar errors.

After having said so much in vindication of analogical conjectures as steps towards physical discoveries, I thought it right to caution my readers against supposing, that what I have stated admits of any application to analogical theories of the human mind. Upon this head, however, I must not enlarge farther at present. In treating of the inductive logic, I have studiously confined my illustrations to those branches of knowledge in which it has already been exemplified with indisputable success; avoiding, for obvious reasons, any reference to sciences in which its utility still remains to be ascertained.

motion of the soul. This infuses a belief, that the mind of man is as a ball in motion, impelled and determined by the objects of sense, as necessarily as that is by the stroke of a racket." (Principles of Human Knowledge.)

III.

Supplemental Observations on the words INDUCTION *and* ANALOGY, *as used in Mathematics.*

BEFORE dismissing the subjects of induction and analogy, considered as methods of reasoning in Physics, it remains for me to take some slight notice of the use occasionally made of the same terms in pure Mathematics. Although, in consequence of the very different natures of these sciences, the induction and analogy of the one cannot fail to differ widely from the induction and analogy of the other, yet, from the general history of language, it may be safely presumed, that this application to both of a common phraseology, has been suggested by certain *supposed* points of coincidence between the two cases thus brought into immediate comparison.*

It has been hitherto, with a very few if any exceptions, the universal doctrine of modern as well as of ancient logicians, that "no mathematical proposition can be proved by induction." To this opinion Dr. Reid has given his sanction in the strongest terms; observing, that "although in a thousand cases, it should be found by experience, that the area of a plane triangle is equal to the rectangle under the base and half the altitude, this would not prove that it must be so in all cases, and cannot be otherwise, which is what the mathematician affirms."*

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* I have already observed (See p. 335 of this volume) that mathematicians frequently avail themselves of that sort of induction which Bacon describes "as proceeding by simple enumeration." The induction, of which I am now to treat, has very little in common with the other, and bears a much closer resemblance to that recommended in the Novum Organon.

That some limitation of this general assertion is necessary, appears plainly from the well-known fact, that *induction* is a species of evidence on which the most scrupulous reasoners are accustomed, in their mathematical inquiries, to rely with implicit confidence; and which, although it may not *of itself* demonstrate that the theorems derived from it are *necessarily* true, is yet abundantly sufficient to satisfy any reasonable mind that they hold *universally.* It was by induction (for example) that Newton discovered the algebraical *formula* by which we are enabled to determine any power whatever, raised from a binomial root, without performing the progressive multiplications. The formula expresses a relation between the exponents and the co-efficients of the different terms, which is found to hold in all cases, as far as the table of powers is carried by actual calculation;—from which Newton inferred, that if this table were to be continued *in infinitum*, the same *formula* would correspond equally with every successive power. There is no reason to suppose that he ever attempted to prove the theorem in any other way; and yet, there cannot be a doubt, that he was as firmly satisfied of its being *universally* true, as if he had examined all the different demonstrations of it which have since been given.* Numberless other illustrations of the same thing might be borrowed, both from arithmetic and geometry.†

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* Essays on the Intell. Powers, p. 615. 4to. edit.

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* "The truth of this theorem was long known only by trial in particular cases, and by *induction* from *analogy*; nor does it appear that even Newton himself ever attempted any direct proof of it." (Hutton's Mathematical Dictionary, Art. Binomial Theorem.) For some interesting information with respect to the history of this discovery, see the very learned Introduction prefixed by Dr. Hutton to his edition of Sherwin's Mathematical Tables; and the second volume (p. 165) of the *Scriptores Logarithmici*, edited by Mr. Baron Maseres.

† In the *Arithmetica Infinitorum* of Dr. Wallis, considerable use is made of the Method of Induction. "A l'aide d'une *induction* habilement ménagée (says Montucla) et du fil de *l'analogie* dont il sçut toujours s'aider avec succès, il soumit à la géométrie une multitude d'objets qui lui avoient échappé jusqu' alors." (Hist. des Mathem. Tome II. p. 299.) This innovation in the established forms of mathematical reasoning gave offence to some of his contemporaries; in particular, to M. de Fermat, one of the most distinguished geometers of the 17th century. The ground of his objection, however, (it is worthy of notice) was not any *doubt* of the conclusions obtained by Wallis; but because he thought that their truth might have been established by a more legitimate and elegant process. "Sa façon de demontrer, qui est fondée sur *induction* plutot que sur un raisonnement à la mode d'Archimede, fera quelque peine aux novices, qui veulent des syllogismes demonstratifs depuis le commencement jusqu' à la fin. Ce n'est pas que je ne l'approuve, mais toutes ses propositions pouvant être demontrées *viâ ordinariâ, legitimâ, et Archimedæâ*, en beaucoup moins de paroles, que n'en contient son livre, je ne sçai pas pourquoi il a préferé cette manière à l'ancienne, qui est plus convainquante et plus elegante, ainsi que j'espere lui faire voir â mon premier loisir." Lettre de M. de Fermat a M. le Chev. Kenelme Digby. (See Fermat's *Varia Opera Mathematica*, p. 191.) For Wallis's reply to these strictures, see his *Algebra*, Cap. lxxix; and his *Commercium Epistolicum*.

In the *Opuscules* of M. Le Sage, I find the following sentence quoted from a work of La Place, which I have not had an opportunity of seeing. The judgment of so great a master, on a logical question relative to his own studies, is of peculiar value. "La methode d'induction, *quoique excellente*

Into what principles, it may be asked, is the validity of such a proof in mathematics ultimately resolvable?—To me it appears to take for granted certain general logical maxims; and to imply a secret process of legitimate and conclusive reasoning, though not conducted agreeably to the rules of mathematical demonstration, nor perhaps formally expressed in words. Thus in the instance mentioned by Dr. Reid, I shall suppose, that I have first ascertained experimentally the truth of the proposition in the case of an equilateral triangle; and that I afterwards find it to hold in all the other kinds of triangles, whether isosceles or scalene, right-angled, obtuse-angled, or acute-angled. It is impossible for me not to perceive, that this property, having no connexion with any of the particular circumstances which discriminate different triangles from each other, *must* arise from something common to all triangles, and *must* therefore be a universal property of that figure. In like manner, in the *binomial theorem*, if the formula correspond with the table of powers in a variety of particular instances, (which instances agree in no other respect, but in being powers raised from the same binomial root,) we must conclude—and, I apprehend that our conclusion is perfectly warranted by the soundest logic,—that it is *this* common property which renders the theorem true in all these cases, and consequently, that it *must necessarily* hold in every other. Whether, on the supposition that we had never had any previous experience of demonstrative evidence, we should have been led by the mere inductive process, to form the idea of *necessary truth*, may perhaps be questioned; but the slightest ac-

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pour découvrir des verités générales, ne doit pas dispenser de les démontrer avec rigueur." (Leçons données aux Ecoles Normales, Prem. Vol. p. 380.)

quaintance with mathematics is sufficient to produce the most complete conviction, that whatever is *universally* true in that science, must be true *of necessity*; and, therefore, that a universal, and a necessary truth, are, in the language of mathematicians, synonymous expressions. If this view of the matter be just, the evidence afforded by mathematical induction must be allowed to differ radically from that of physical; the latter resolving ultimately into our instinctive expectation of the laws of nature, and consequently, never amounting to that demonstrative certainty, which excludes the possibility of anomalous exceptions.

I have been led into this train of thinking by a remark which La Place appears to me to have stated in terms much too unqualified;—"Que la marche de Newton, dans la découverte de la gravitation universelle, a été *exactement* la même, que dans celle de la formule du binome." When its recollected, that, in the one case, Newton's conclusion related to a *contingent*, and in the other to a *necessary* truth, it seems difficult to conceive, how the logical procedure which conducted him to both should have been *exactly* the same. In one of his queries, he has (in perfect conformity to the principles of Bacon's logic) admitted the possibility, that "God may vary the laws of nature, and make worlds of several sorts, in several parts of the universe." "At least, (he adds) I see nothing of contradiction in all this."* Would Newton have expressed himself with equal scepticism concerning the universality of his binomial theorem; or admitted the possibility of a single exception to it, in the indefinite progress of actual involution? In short, did there exist the slightest shade of difference between the degree of his assent to this *inductive result*, and that extorted from him by a demonstration of Euclid?

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* Query 31.

Although, therefore, the mathematician, as well as the natural philosopher, may, without any blameable latitude of expression, be said to reason by *induction*, when he draws an inference from the known to the unknown, yet it seems indisputable, that, in all such cases, he rests his conclusions on grounds essentially distinct from those which form the basis of experimental science.

The word *analogy*, too, as well as *induction*, is common to physics and to pure mathematics. It is thus we speak of the analogy running through the general properties of the different conic sections, with no less propriety than of the analogy running through the anatomical structure of different tribes of animals. In some instances, these mathematical analogies are collected by a species of *induction*; in others, they are inferred as consequences from more general truths, in which they are included as particular cases. Thus, in the curves which have just been mentioned, while we content ourselves (as many elementary writers have done)* with deducing their properties from mechanical descriptions on a plane, we rise experimentally from a comparison of the propositions which have been separately demonstrated with respect to each curve, to more comprehensive theorems, applicable to all of them; whereas, when we begin with considering them in their common origin, we have it in our power to trace from the source, both their generic properties, and their specific peculiarities. The satisfaction arising from this last view of the subject can be conceived by those alone who have experienced it; although I am somewhat doubtful whether it be not felt in the greatestdegree by such as, after having risen from the contemplation of particular truths to other truths more general, have been at last conducted to some commanding station, where the mutual connexions and affinities of the whole system are brought, at once, under the range of the eye. Even, however, before we have reached this vantage-ground, the contemplation of the analogy, considered merely as a *fact*, is pleasing to the mind; partly, from the mysterious wonder it excites, and partly from the convenient generalization of knowledge it affords. To the experienced mathematician this pleasure is farther enhanced, by the assurance which the analogy conveys, of the existence of yet undiscovered theorems, far more extensive and luminous than those which have led him by a process so indirect, so tedious, and comparatively so unsatisfactory, to his general conclusions.

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* L'Hospital, Simson, &c.

In this last respect, the pleasure derived from analogy in mathematics, resolves into the same principle with that which seems to have the chief share in rendering the analogies among the different departments of nature so interesting a subject of speculation. In both cases, a powerful and agreeable *stimulus* is applied to the curiosity, by the encouragement given to the exercise of the inventive faculties, and by the hope of future discovery, which is awakened and cherished. As the analogous properties (for instance) of the conic sections, point to some general theorems of which they are corollaries; so the analogy between the pheuomena of Electricity and those of Galvanism irresistibly suggests a confident, though vague anticipation of some general physical law comprehending the phenomena of both, but differently modified in its sensible results by a diversity of circumstances.* Indeed, it is by no means impossible, that the pleasure we receive even from those analogies which are the foundation of poetical metaphor and simile, may be found resolvable, in part, into the satisfaction connected with the *supposed* discovery of truth, or the *supposed* acquisition of knowledge: the faculty of imagination giving to these illusions a momentary ascendent over the sober conclusions of experience: and gratifying the understanding with a flattering consciousness of its own force, or at least with a consolatory forgetfulness of its own weakness.

SECTION V.

Of certain misapplications of the words Experience and Induction in the phraseology of Modern Science. Illustrations from Medicine and from Political Economy.

In the first Section of this Chapter, I endeavoured to point out the characteristical peculiarities by which the Inductive Philosophy of the Newtonians is distinguished from the hypothetical systems of their predecessors: and which entitle us to indulge hopes with respect to the permanent stability of their doctrines, which might be regarded as chimerical, if, in anticipating the future history of science, we were to be guided merely by the analogy of its revolutions in the ages that are past.

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* See Note (Y.)

In order, however, to do complete justice to this argument, as well as to prevent an undue extension of the foregoing conclusions, it is necessary to guard the reader against a vague application of the appropriate terms of *inductive science* to inquiries which have not been rigorously conducted, according to the rules of the *inductive logic*. From a want of attention to this consideration, there is a danger, on the one hand, of lending to sophistry or to ignorance the authority of those illustrious names whose steps they profess to follow; and, on the other, of bringing discredit on that method of investigation, of which the language and other technical arrangements have been thus perverted.

Among the distinguishing features of the new logic, when considered in contrast with that of the schoolmen, the most prominent is the regard which it professes to pay to *experience*, as the only solid foundation of human knowledge. It may be worth while, therefore, to consider, how far the notion commonly annexed to this word is definite and precise; and whether there may not sometimes be a possibility of its being employed in a sense more general and loose, than the authors who are looked up to as the great models of inductive investigation understood it to convey.*

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* As the reflections which follow are entirely of a practical nature, I shall express myself (as far as is consistent with a due regard to precision) agreeably to the modes of speaking in common use; without affecting a scrupulous attention to some speculative distinctions, which, however

In the course of the abstract speculations contained in the preceding section, I have remarked, that although the difference between the two sorts of evidence, which are

curious and interesting, when considered in connexion with the Theory of the Mind, do not lead to any logical conclusions of essential importance in the conduct of the Understanding. In such sciences, for example, as Astronomy, Natural Philosophy, and Chemistry, which rest upon phenomena open to the scrutiny of every inquirer, it would obviously be puerile in the extreme to attempt drawing the line between facts which have been ascertained by our own personal observation, and those which we have implicitly adopted upon our faith in the universal consent of the scientific world. The evidence, in both cases, may be equally irresistible: and sometimes the most cautious reasoners may justly be disposed to consider that of testimony as the least fallible of the two.

By far the greater part, indeed, of what is commonly called experimental knowledge, will be found, when traced to its origin, to resolve entirely into our confidence in the judgment and the veracity of our fellow-creatures; nor (in the sciences already mentioned) has this identification of the evidence of testimony with that of experience, the slightest tendency to affect the legitimacy of our inductive conclusions.

In some other branches of knowledge, (more particularly in those political doctrines which assume as incontrovertible *data* the details of ancient history) the authority of testimony is, for obvious reasons, much more questionable; and to dignify it, in *these*, with the imposing character of *experience*, is to strengthen one of the chief bulwarks of popular prejudices. This view of the subject, however, although well entitled to the attention of the logician, has no immediate connexion with my present argument; and accordingly I shall make no scruple, in the sequel, to comprehend under the name of *experience*, the grounds of our assent to all the *facts* on which our reasonings proceed, provided only that the certainty of these facts be, on either supposition, equally indisputable.

The logical errors which it is the aim of this section to correct, turn upon a still more dangerous latitude in the use of this word; in consequence of which, the authority of *experience* comes insensibly to be extended to innumerable opinions resting solely on *supposed analogies;* while not unfrequently the language of Bacon is quoted in bar of any theoretical argument on the other side of the question.

commonly referred to the separate heads of *experience* and of *analogy*, be rather a difference in *degree* than in *kind*, yet that it is useful to keep these terms in view, in order to mark the contrast between cases which are separated from each other by a very wide and palpable interval;—more especially, to mark the difference between an argument from individual to individual of the same species, and an argument from species to species of the same genus. As this distinction, however, when accurately examined, turns out to be of a more vague and popular nature than at first sight appears, it is not surprising that instances should occasionally present themselves, in which it is difficult to say, of the evidence before us, to which of these descriptions it ought to be referred. Nor does this doubt lead merely to a question concerning phraseology: it produces a hesitation which must have some effect even on the judgment of a philosopher; the maxims to which we have been accustomed, in the course of our early studies, leading us to magnify the evidence of *experience* as the sole test of truth; and to depreciate that of *analogy*, as one of the most fertile sources of error. As these maxims proceed on the supposition, that the respective provinces of both are very precisely defined, it is evident, that, admitting them to be perfectly just in themselves, much danger may still be conceivable from their injudicious application. I shall endeavour to illustrate this remark by some familiar instances; which, I

I have added this note, partly to obviate some criticisms, to which my own phraseology may, at first sight, appear liable; and partly to point out the connexion between the following discussion, and some of the foregoing speculations.

trust, will be sufficient to recommend it to the farther consideration of future logicians. To treat of the subject with that minuteness of detail which is suited to its importance, is incompatible with the subordinate place which belongs to it in my general design.

It is observed by Dr. Reid,* that "in medicine, physicians must, for the most part, be directed in their prescriptions by *analogy*. The constitution of one human body is so like to that of another, that it is reasonable to think, that what is the cause of health or sickness to one, may have the same effect on another. And this (he adds) is generally found true, though not without some exceptions."

I am doubtful if this observation be justified by the common use of language; which as far as I am able to judge, uniformly refers the evidence on which a cautious physician proceeds, not to *analogy* but to *experience*. The German monk, who, (according to the popular tradition) having observed the salutary effects of antimony upon some of the lower animals, ventured to prescribe the use of it to his own fraternity, might be justly said to reason analogically; inasmuch as his experience related to one species, and his inference to another. But if, after having thus poisoned all the monks of his own convent, he had persevered in recommending the same mineral to the monks of another, the example of our most correct writers would have authorized us to say, (how far justly is a different question) that he proceeded in direct opposition to the evidence of *experience*.

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* Essays on the Intellect. Powers, p. 53.

In offering this slight criticism on Dr. Reid, I would be very far from being understood to say, that the common phraseology is more unexceptionable than his. I would only remark, that his phraseology on this occasion is almost peculiar to himself; and that the prevailing opinions, both of philosophers and of the multitude, incline them to rank the grounds of our reasoning in the medical art, at a much higher point in the scale of evidence, than what is marked by the word *analogy*. Indeed, I should be glad to know, if there be any one branch of human knowledge, in which men are, in general, more disposed to boast of the lights of *experience*, that in the practice of medicine.

It would, perhaps, have been better for the world, if the general habits of thinking and of speaking, had, in this instance, been more agreeable than they seem to be in fact, to Dr. Reid's ideas;—or, at least, if some qualifying epithet had been invariably added to the word *experience*, to show with how very great latitude it is to be understood, when applied to the evidence on which the physician proceeds in the exercise of his art. The truth is, that, even on the most favourable supposition, this evidence, so far as it rests on experience, is weakened or destroyed by the uncertain conditions of every new case to which his former results are to be applied; and that, without a peculiar sagacity and discrimination in marking, not only the resembling, but the characteristical features of disorders, classed under the same technical name, his practice cannot, with propriety, be said to be guided by any one rational principle of decision, but merely by blind and random conjecture. The more successfully this sagacity and discrimination are exercised, the more nearly does the evidence of medical practice approach to that of *experience;* but, in every instance, without exception, so immense is the distance between them, as to render the meaning of the word *experience,* when applied to medicine, essentially different from its import in those sciences where it is possible for us, in all cases, by due attention to the circumstances of an experiment, to predict its result with an almost infallible certainty."*

Notwithstanding this very obvious consideration, it has become fashionable among a certain class of medical practitioners, since the lustre thrown on the inductive logic of Bacon by the discoveries of Newton and the researches of Boyle, to number their art with the other branches of experimental philosophy; and to speak of the difference between the empiric and the scientific physician, as if it were exactly analogous to that between the cautious experimenter and the hypothetical theorist in physics.

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* L'art de conjecturer en Médicine ne sauroit consister dans une suite de raisonnemens appuyés sur un vain systême. C'est uniquement l'art de comparer une maladie qu'on doit guérir, avec les maladies semblables qu'on a déja connues par son experience ou par celle des autres. Cet art consiste même quelquefois à appercevoir un rapport entre des maladies qui paroissent n'en point avoir, comme aussi des differences essentielles, quoique fugitives, entre celles qui paroissent se ressembler le plus. Plus on aura rassemblé de faits, plus on sera en état de conjecturer heureusement; supposé nèanmoins qu'on ait d'ailleurs cette justesse d'esprit que la nature seule peut donner.

"Ainsi le meilleur médecin n'est pas (comme le préjugé le suppose) celui qui accumule en aveugle et en courant beaucoup de pratique, mais celui qui ne fait que des observations bien approfondies, et qui joint à ces observations le nombre beaucoup plus grand des observations faites dans tous les siecles par des hommes animés du même esprit que lui. Ces observations sont la véritable *expérience* du médecin." D'Alembert, Eclaircissemens sur les Elémens de Philosophie, § vi.

Experience, (we are told) and experience alone, must be our guide in medicine as in all the other departments of physical knowledge:—Nor is any innovation, however rational, proposed in the established routine of practice, but an accumulation of alleged cases is immediately brought forward as an experimental proof of the dangers which it threatens.

It was a frequent and favourite remark of the late Dr. Cullen,—that there are more false facts current in the world than false theories; and a similar observation occurs, more than once, in the *Novum Organon*. "Men of learning (says Bacon in one passage) are too often led, from indolence or credulity, to avail themselves of mere *rumours or whispers of experience*, as confirmations, and sometimes as the very groundwork of their philosophy; ascribing to them the same authority as if they rested on legitimate testimony. Like to a government which should regulate its measures, not by the official information received from its own accredited ambassadors, but by the gossipings of newsmongers in the streets. Such, in truth, is the manner in which the interests of philosophy, as far as *experience* is concerned, have been hitherto administered. Nothing is to be found which has been duly investigated; nothing which has been verified by a careful examination of proofs; nothing which has been reduced to the standard of number, weight, or measure."*

This very important aphorism deserves the serious attention of those who, while they are perpetually declaiming against the uncertainty and fallacy of systems, are themselves employed in amassing a chaos of insulated particulars, which they admit upon the slenderest evidence. Such men, sensible of their own incapacity for scientific investigation, have often a malicious pleasure in destroying the fabrics of their predecessors; or, if they should be actuated by less unworthy motives, they may yet feel a certain gratification to their vanity, in astonishing the world with anomalous and unlooked-for phenomena;—a weakness which results not less naturally from ignorance and folly, than a bias to premature generalization from the consciousness of genius.—Both of these weaknesses are unboubtedly adverse to the progress of science; but, in the actual state of human knowledge, the former is perhaps the more dangerous of the two.

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* Nov. Org. Lib. I. Aph. xcviii.

In the practice of *medicine* (to which topic I wish to confine myself more particularly at present) there are a variety of other circumstances, which, abstracting from any suspicion of bad faith in those on whose testimony the credibility of facts depends, have a tendency to vitiate the most candid accounts of what is commonly dignified with the title of *experience*. So deeply rooted in the constitution of the mind is that disposition on which philosophy is grafted, that the simplest narrative of the most illiterate observer involves more or less of hypothesis; nay, in general, it will be found, that, in proportion to his ignorance, the greater is the number of conjectural principles involved in his statements.

A village-apothecary (and, if possible, in a still greater degree, an experienced nurse) is seldom able to describe the plainest case, without employing a phraseology of which every word is a theory; whereas a simple and genuine specification of the phenomena which mark a particular disease;—a specification unsophisticated by fancy, or by preconceived opinions, may be regarded as unequivocal evidence of a mind trained by long and successful study to the most difficult of all arts, that of the faithful *interpretation of nature.*

Independently, however, of all these circumstances, which tend so powerfully to vitiate the *data* whence the physician has to reason; and supposing his assumed facts to be stated, not only with the most scrupulous regard to truth, but with the most jealous exclusion of theoretical expressions, still the evidence upon which he proceeds is, at best, conjectural and dubious, when compared with what is required in chemistry or in mechanics. It is seldom, if ever, possible, that the description of any medical case can include all the circumstances with which the result was connected; and, therefore, how true soever the facts described may be, yet when the conclusion to which they lead comes to be applied as a general rule in practice, it is not only a rule rashly drawn from one single experiment, but a rule transferred from a case imperfectly known, to another of which we are equally ignorant. Here, too, it will be found, that the evidence of experience is incomparably less in favour of the empiric, than of the cautious theorist; or rather that it is by cautious theory alone, that experience can be rendered of any value. Nothing, indeed, can be more absurd than to contrast, as is commonly done, experience with theory, as if they stood in opposition to each other. Without theory, (or, in other words, without general principles, inferred from a sagacious comparison of a variety of phenomena,) experience is a blind and useless guide; while, on the other hand, a legitimate theory (and the same observation may be extended to hypothetical theories, supported by numerous analogies,) necessarily presupposes a knowledge of connected and well ascertained facts, more comprehensive, by far, than any mere empiric is likely to possess. When a scientific practitioner, accordingly, quits the empirical routine of his profession, in quest of a higher and more commanding ground, he does not proceed on the supposition that it is possible to supersede the necessity of experience by the most accurate reasonings *a priori;* but, distrusting conclusions which rest on the observation of this or that individual, he is anxious, by combining those of an immense multitude, to separate accidental conjunctions from established connexions, and to ascertain those laws of the human frame which rest on the universal experience of mankind. The idea of following nature in the treatment of diseases;—an idea which, I believe, prevails more and more in the practice of every physician, in proportion as his views are enlarged by science, is founded, not on hypothesis, but on one of the most general laws yet known with respect to the animal economy; and it implies an acknowledgment, not only of the vanity of abstract theories, but of the limited province of human art.[*]

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[*] "Gaudet corpus vi prorsus mirabili, qua contra morbos se tueatur; multos arceat; multos jam inchoatos quam optime et citissime solvat; aliosque suo modo, ad felicem exitum lentius perducat.

"Hæc, *Autocrateia*, *vis Naturæ medicatrix*, vocatur; medicis, philosophis, notissima, et jure celeberrima. Hæc sola ad multos morbos sanandos sufficit, in omnibus fere prodest: Quin et medicamenta sua natura optima, tantum solummodo prosunt, quantum hujus vires insitas excitent, dirigant, gubernent. Medicina enim neque agit in cadaver, neque repugnante natura aliquid proficit."

Conspectus Medicinæ Theoreticæ. Auctore Jacobo Gregory, M. D. §§. 59, 60. (Edin. 1782.)

These slight remarks are sufficient to show, how vague and indeterminate the notion is, which is commonly annexed to the word *experience* by the most zealous advocates for its paramount authority in medicine. They seem farther to show, that the question between them and their adversaries amounts to little more than a dispute about the comparative advantages of an experience guided by penetration and judgment, or of an experience which is to supersede all exercise of our rational faculties; of an experience accurate, various, and discriminating, or of one which is gross and undistinguishing, like the perceptions of the lower animals.

Another department of knowledge in which constant appeals are made to *experience*, is the science of *politics;* and, in this science also, I apprehend, as well as in the former, that word is used with a far greater degree of latitude than is generally suspected. Indeed, most of the remarks which have been already offered on the one subject, may be extended (*mutatis mutandis*) to the other. I shall confine my attention, therefore, in what follows, to one or two peculiarities by which politics is specifically and exclusively characterized as an object of study; and which seem to remove the species of evidence it admits of, to a still greater distance than that of *medicine* itself, from what the word *experience* naturally suggests to a careless inquirer.

The science of politics may be divided into two parts; the first having for its object the theory of government; the second, the general principles of legislation. That I may not lose myself in too wide a field, I shall, on the present occasion, waive all consideration of the former;

and, for the sake of still greater precision, shall restrict my remarks to those branches of the latter, which are comprehended under the general title of *Political Economy;* —a phrase, however, which I wish to be here understood in its most extensive meaning.*

They who have turned their attention, during the last century, to inquiries connected with population, national wealth, and other collateral subjects, may be divided into two classes; to the one of which we may, for the sake of distinction, give the title of *political arithmeticians*, or *statistical collectors;* to the other, that of *political economists*, or *political philosophers*. The former are generally supposed to have the evidence of experience in their favour, and seldom fail to arrogate to themselves exclusively, the merit of treading closely in the footsteps of *Bacon*. In comparison with *them*, the latter are considered as little better than visionaries, or, at least, as entitled to no credit whatever, when their conclusions are at variance with the details of *statistics*.

In opposition to this prevailing prejudice, it may, with confidence, be asserted, that, in so far as either of these branches of knowledge has any real value, it must rest on a basis of well-ascertained facts; and that the difference between them consists only in the different nature of the facts with which they are respectively conversant. The facts accumulated by the statistical collector are merely *particular results*, which other men have seldom an opportunity of verifying or of disproving; and which, to those who consider them in an insulated state, can never afford any important information. The facts which the political philosopher professes to investigate are exposed to the examination of all mankind; and while they enable him, like the general laws of physics, to ascertain numberless particulars by *synthetic reasoning*, they furnish the means of estimating the credibility of evidence resting on the testimony of individual observers.

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* See Note (Z.)

It is acknowledged by Mr. Smith, with respect to himself, that he had "no great faith in political arithmetic;"* and I agree with him so far as to think that little, if any, regard is due to a *particular phenomenon*, when stated as an objection to a conclusion resting on the *general laws* which regulate the course of human affairs. Even admitting the phenomenon in question to have been accurately observed, and faithfully described, it is yet possible that we may be imperfectly acquainted with that combination of circumstances whereby the effect is modified; and that if these circumstances were fully before us, this apparent exception would turn out an additional illustration of the very truth which it was brought to invalidate.

If these observations be just, instead of appealing to political arithmetic as a check on the conclusions of political economy, it would often be more reasonable to have recourse to political economy as a check on the extravagancies of political arithmetic. Nor will this assertion appear paradoxical to those who consider, that the object of the political arithmetician is too frequently to record apparent exceptions to rules sanctioned by the general experience of mankind; and, consequently, that, in cases where there is an obvious or a demonstrative incompatibility between the alleged exception and the general principle, the fair logical inference is not against the truth of the latter, but against the possibility of the former.

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* Wealth of Nations, Vol. II. p. 319. 9th Edit.

It has long been an established opinion among the most judicious and enlightened philosophers,—that *as the desire of bettering our condition appears equally from a careful review of the motives which habitually influence our own conduct, and from a general survey of the history of our species, to be the master-spring of human industry*, the labour of slaves never can be so productive as that of freemen. Not many years have elapsed, since it was customary to stigmatize this reasoning as visionary and metaphysical; and to oppose to it that species of evidence to which we were often reminded that all theories must bend;—the evidence of experimental calculations, furnished by intelligent and credible observers on the other side of the Atlantic. An accurate examination of the fact has shown how wide of the truth these calculations were;—but independently of any such detection of their fallacy, might it not have been justly affirmed, that the argument from *experience* was decidedly against their credibility;—the facts appealed to resting solely upon the good sense and good faith of individual witnesses; while the opposite argument, drawn from the principles of the human frame, was supported by the united voice of all nations and ages?

If we examine the leading principles which run through Mr. Smith's Inquiry into the Nature and Causes of the Wealth of Nations, we shall find, that all of them are general *facts* or general *results*, analogous to that which has been just mentioned. Of this kind, for instance, are the following propositions,—from which a very large proportion of his characteristical doctrines follow, as necessary and almost manifest corrollaries: That what we call the Political Order, is much less the effect of human contrivance than is commonly imagined;—That every man is a better judge of his own interest than any legislator can be for him; and that this regard to private interest (or, in other words, this desire of bettering our condition) may be safely trusted to as a principle of action universal among men in its operation;—a principle stronger, indeed, in some than in others, but constant in its habitual influence upon all:—That, where the rights of individuals are completely protected by the magistrate, there is a strong tendency in human affairs, arising from what we are apt to consider as the selfish passions of our nature, to a progressive and rapid improvement in the state of society: —That this tendency to improvement in human affairs is often so very powerful, as to correct the inconveniences threatened by the errors of the statesman:—And that, therefore, the reasonable presumption is in favour of every measure which is calculated to afford to its farther developement, a scope still freer than what it at present enjoys; or which amounts very nearly to the same thing, in favour of as great a liberty in the employment of industry, of capital, and of talents, as is consistent with the security of property, and of the other rights of our fellow-citizens. —The premises, it is perfectly obvious, from which these conclusions are deduced, are neither hypothetical assumptions, nor metaphysical abstractions. They are practical maxims of good sense, approved by the experience of men in all ages of the world; and of which, if we wish for any additional confirmations, we have only to retire within our own bosoms, or to open our eyes on what is passing around us.

From these considerations it would appear, that in politics, as well as in many of the other sciences, the loudest advocates for experience are the least entitled to appeal to its authority in favour of their dogmas; and that the charge of a presumptuous confidence in human wisdom and foresight, which they are perpetually urging against political philosophers, may, with far greater justice, be retorted on themselves. An additional illustration of this is presented by the strikingly contrasted effects of *statistical* and of *philosophical* studies on the intellectual habits in general;—the former invariably encouraging a predilection for restraints and checks, and all the other technical combinations of an antiquated and scholastic policy;—the latter, by inspiring, on the one hand, a distrust of the human powers, when they attempt to embrace in detail, interests at once so complicated and so momentous: and, on the other, a religious attention to the designs of Nature, as displayed in the general laws which regulate her economy;—leading, no less irresistibly, to a gradual and progressive simplification of the political mechanism. It is, indeed, the never-failing result of all sound philosophy, to humble, more and more, the pride of science before that Wisdom which is infinite and divine;—whereas, the farther back we carry our researches into those ages, the institutions of which have been credulously regarded as monuments of the superiority of unsophisticated good sense, over the false refinements of modern arrogance, we are the more struck with the numberless insults offered to the most obvious suggestions of nature and of reason. We may remark this, not only in the moral depravity of rude tribes, but in the universal disposition which they discover to disfigure and distort the bodies of their infants;—in one case, new-modelling the form of the eye-lids;—in a second, lengthening the ears;—in a third, checking the growth of the feet;—in a fourth, by mechanical pressures applied to the head, attacking the seat of thought and intelligence. To allow the human form to attain, in perfection, its fair proportions, is one of the latest improvements of civilized society; and the case is perfectly analogous in those sciences which have for their object to assist nature in the cure of diseases; in the developement and improvement of the intellectual faculties; in the correction of bad morals; and in the regulations of *political economy*.

SECTION VI.

Of the Speculation concerning Final Causes.

I.

Opinion of Lord Bacon on the Subject.—Final Causes rejected by Des Cartes, and by the majority of French Philosophers.—Recognized as legitimate Objects of research by Newton.—Tacitly acknowledged by all as a useful logical Guide, even in Sciences which have no immediate relation to Theology.

THE study of Final Causes may be considered in two different points of view; first, as subservient to the evidences of natural religion; and secondly, as a guide and auxiliary in the investigation of physical laws. Of these views it is the latter alone which is immediately connected with the principles of the inductive logic; and it is to this, accordingly, that I shall chiefly direct my attention in the following observations. I shall not, however, adhere so scrupulously to a strict arrangement, as to avoid all reference to the former, where the train of my reflections may naturally lead to it. The truth is, that the two speculations will, on examination, be found much more nearly allied, than might at first sight be apprehended.

I before observed, that the phrase *Final Cause* was first introduced by Aristotle; and that the extension thus given to the notion of *causation* contributed powerfully to divert the inquiries of his followers from the proper objects of physical science. In reading the strictures of Bacon on this mode of philosophizing, it is necessary always to bear in mind, that they have a particular reference to the theories of the schoolmen; and, if they should sometimes appear to be expressed in terms too unqualified, due allowances ought to be made for the undistinguishing zeal of a reformer, in attacking prejudices consecrated by long and undisturbed prescription. "*Causarum finalium inquisitio sterilis est, et tanquam Virgo Deo consecrata, nihil parit.*" Had a similar remark occurred in any philosophical work of the eighteenth century, it might perhaps have been fairly suspected to savour of the school of Epicurus; although, even in such a case, the quaintness and levity of the conceit would probably have inclined a cautious and candid reader to interpret the author's meaning with an indulgent latitude. On the present occasion, however, Bacon is his own best commentator; and I shall therefore quote, in a faithful, though abridged translation, the preparatory passage by which this allusion is introduced.

"The second part of *metaphysics* is the investigation of *final causes;* which I object to, not as a speculation which ought to be neglected, but as one which has, in general, been very improperly regarded as a branch of *physics.* If this were merely a fault of arrangement, I should not be disposed to lay great stress upon it; for arrangement is useful chiefly as a help to perspicuity, and does not affect the substantial matter of science: But, in this instance, a disregard of *method* has occasioned the most fatal consequences to philosophy; inasmuch as the consideration of *final* causes in physics has supplanted and banished the study of *physical* causes; the fancy amusing itself with illusory explanations derived from the former, and misleading the curiosity from a steady prosecution of the latter." After illustrating this remark by various examples, Bacon adds: "I would not, however, be understood, by these observations, to insinuate, that the *final causes* just mentioned may not be founded in truth, and, in a *metaphysical* view, extremely worthy of attention; but only, that when such disquisitions invade and overrun the appropriate province of *physics*, they are likely to lay waste and ruin that department of knowledge." "The passage concludes with these words: "And so much concerning *metaphysics;* the part of which relating to *final causes*, I do not deny, has been often enlarged upon in physical, as well as in metaphysical treatises. But while, in the latter of these, it is treated of with propriety, in the former, it is altogether misplaced; and *that*, not merely because it violates the rules of a logical order, but because it operates as a powerful obstacle to the progress of inductive science."*

The epigrammatic maxim which gave occasion to these extracts has, I believe, been oftener quoted (particularly by French writers) than any other sentence in Bacon's works; and, as it has in general been stated, without any reference to the context, in the form of a detached aphorism, it has been commonly supposed to convey a meaning widely different from what appears to have been annexed to it by the author. The remarks with which he has prefaced it, and which I have here submitted to the consideration of my readers, sufficiently show, not only that he meant his proposition to be restricted to the abuse of final causes in the physics of Aristotle, but that he was anxious to guard against the possibility of any misapprehension or misrepresentation of his opinion. A farther proof of this is afforded by the censure which, in the same paragraph, he bestows on Aristotle, for, "substituting Nature, instead of God, as the fountain of final causes; and for treating of them rather as subservient to logic than to theology."

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* De Augm. Scient. Lib. III. Cap. iv. v. See Note (AA.)

A similar observation may be made on another sentence in Bacon, in the interpretation of which a very learned writer, Dr. Cudworth, seems to have altogether lost sight of his usual candour. "Incredibile est quantum agmen idolorum philosophiæ immisserit, naturalium operationum ad similitudinem actionum humanarum reductio." "If (says Cudworth) the Advancer of Learning here speaks of those who unskilfully attribute their own properties to inanimate bodies, (as when they say, that matter *desires* forms as the female does the males, and that heavy bodies descend down *by appetite* towards the centre, that they may rest therein) there is nothing to be reprehended in the passage. But, if his meaning be extended further to take away all final causes from the things of nature, then is it the very spirit of atheism and infidelity. It is no *idol of the cave or den* (to use that affected language) that is, no prejudice or fallacy imposed on ourselves, from the attributing our own animalish properties to things without us, to think that the frame and system of this whole world was contrived by a perfect understanding and mind."

It is difficult to conceive that any person who had read Bacon's works, and who, at the same time, was acquainted with the theories which it was their great object to explode, could, for a moment, have hesitated about rejecting the latter interpretation as altogether absurd; and yet the splenetic tone which marks the conclusion of Cudworth's strictures, plainly shows, that he had a decided leaning to it, in preference to the former.* The comment does no honour to his liberality; and, on the most favourable supposition, must be imputed to a superstitious reverence for the remains of Grecian wisdom, accompanied with a corresponding dread of the unknown dangers to be apprehended from philosophical innovations. Little was he aware, that, in turning the attention of men from the history of opinions and systems, to the observation and study of nature, Bacon was laying the foundation of a bulwark against atheism, more stable and impregnable than the united labours of the ancients were able to rear;—a bulwark which derives additional strength from every new accession to the stock of human knowledge.*

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* Even the *former* interpretation is not agreeable (as appears manifestly from the context) to Bacon's idea. The prejudices which he has here more particularly in view, are those which take their rise from a bias in the mind to imagine a greater *equality* and *uniformity* in nature than really exists. As an instance of this, he mentions the universal assumption among the ancient astronomers, that all the celestial motions are performed in orbits perfectly circular;—an assumption, which, a few years before Bacon wrote, had been completely disproved by Kelper. To this he adds some other examples from physics and chemistry; after which he introduces the general reflection animadverted on by Cudworth.—The whole passage concludes with these words. "Tanta est harmoniæ discrepantia inter spiritum hominis et spiritum mundi."

The criticism may appear minute; but I cannot forbear to mention, as a proof of the carelessness with which Cudworth had read Bacon, that the prejudice supposed by the former to belong to the class of *idola specus*, is expressly quoted by the latter, as an example of the *idola tribus*. (See the 5th Book de Augment. Scient. Chap. iv.

Whether Bacon's contempt for the Final Causes of the Aristotelians has not carried him to an extreme in recommending the *total* exclusion of them from physics, is a very different question; and a question of much importance in the theory of the inductive logic. My own opinion is, that his views on this point, if considered as applicable to the *present* state of experimental science, are extremely limited and erroneous. Perhaps, at the time when he wrote, such and exclusion may have appeared necessary, as the only effectual antidote against the errors which then infected every branch of philosophy; but granting this to be true, no good reason can be given for continuing the same language, at a period when the proper object of physics is too well understood, to render it possible for the investigation of final causes to lead astray the most fanciful theorist. What harm can be apprehended from remarking those proofs of design which fall under the view of the physical inquirer in the course of his studies? Or, if it should be thought foreign to *his* province to speak of *design*, he may, at least, be permitted to remark what *ends* are really accomplished by particular *means;* and what *advantages* result from the general laws by which the phanomena of nature are regulated. In doing this, he only states *a fact;* and if it be illogical to go farther, he may leave the inference to the moralist or the divine.

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* Extabit eximium Newtoni opus adversus Atheorum impetus munitissimum præsidium. (Cotesii Præf. in Edit. Secund. Princip.)

In the above vindication of Bacon, I have abstained from any appeal to the instances in which he has himself forcibly and eloquently expressed the same sentiments here ascribed to him; because I conceive that an author's real opinions are to be most indisputably judged of from the *general* spirit and tendency of his writings. The following passage, however, is too precious a document to be omitted on the present occasion. It is indeed one of the most hackneyed quotations in our language; but it forms, on that very account, the more striking a contrast to the voluminous and now neglected erudition displayed by Cudworth in defence of the same argument.

"I had rather believe all the fables in the Legend, and the Talmud, and the Alcoran, than that this universal frame is without a mind! It is true that a little philosophy inclineth man's mind to atheism; but depth in philosophy bringeth men's minds about to religion; for while the mind of man looketh upon second causes scattered, it may sometimes rest in them and go no farther; but when it beholdeth the chain of them confederate and linked together, it must needs fly to providence and Deity: nay, even that school which is most accused of atheism, doth most demonstrate religion; that is, the school of Leucippus, and Democritus, and Epicurus: for it is a thousand times more credible, that four mutable elements and one immutable fifth essence, duly and eternally placed, need no God, than that an army of infinite small portions, or seeds unplaced, should have produced this order and beauty without a divine marshal." (Bacon's Essays.)

In consequence, however, of vague and common-place declamation against final causes, sanctioned (as has been absurdly supposed) by those detached expressions of Bacon, which have suggested the foregoing reflections, it has for many years past become fashionable to omit the consideration of them entirely, as inconsistent with the acknowledged rules of sound philosophizing;—a caution (it may be remarked by the way) which is most scrupulously observed by those writers who are the most forward to censure every apparent *anomaly* or *disorder* in the economy of the universe. The effect of this has been, to divest the study of nature of its most attractive charms; and to sacrifice to a false idea of logical rigour, all the moral impressions and pleasures which physical knowledge is fitted to yield.*

Nor is it merely in a *moral view*, that the consideration of *uses* is interesting. There are some parts of nature in which it is necessary to complete the *physical theory;* nay, there are instances, in which it has proved a powerful and perhaps indispensable organ of *physical discovery*. That Bacon should not have been aware of this, will not appear surprising, when it is recollected, that the chief facts which justify the observation have been brought to light since his time.

Of these *facts*, the most remarkable are furnished by the science of anatomy. To understand the structure of an animal body, it is necessary not only to examine the *conformation* of the parts, but to consider their *functions;* or, in other words, to consider their *ends* and *uses:* nor indeed, does the most accurate knowledge of the former, till perfected by the discovery of the latter, afford satisfaction to an inquisitive and scientific mind. Every ana-

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* "If a traveller (says the great Mr. Boyle) being in some ill-inhabited eastern country, should come to a large and fair building, such as one of the most stately of those they call caravanzeras, though he would esteem and be delighted with the magnificence of the structure, and the commodiousness of the apartments, yet supposing it to have been erected but for the honour or the pleasure of the founder, he would commend so stately a fabric, without thanking him for it; but, if he were satisfied that this commodious building was designed by the founder as a receptacle for passengers, who were freely to have the use of the many conveniences the apartments afforded, he would then think himself obliged, not only to praise the magnificence, but with gratitude to acknowledge the bounty and the philanthropy of so munificent a benefactor." (Boyle's Works, Vol. IV. p. 517. Folio edition.)

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through the arteries, and return through the veins whose valves did not oppose its course that way."[*]

This perception of design and contrivance is more peculiarly impressive, when we contemplate those instances in the animal economy, in which the same effect is produced, in *different* combinations of circumstances, by *different* means:—when we compare, for example, the circulation of the blood in the fœtus, with that in the body of the animal after it is born. On such an occasion, how is it possible to withhold the assent from the ingenious reflection of Baxter! "Art and means are designedly multiplied, that we might not take it for the effects of chance; and, in some cases, the method itself is different, that we might see it is not the effect of surd necessity."*

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[*] Boyle's Works, Vol. IV. p. 539. Folio Edit. See Outlines of Moral Philosophy, p. 185. (Edin. 1793.)

The reasoning here ascribed to Harvey seems now so very natural and obvious, that some have been disposed to question his claim to the high rank commonly assigned to him among the improvers of science. The late Dr. William Hunter has said, that after the discovery of the valves in the veins, which Harvey learned, while in Italy, from his master Fabricius ab Aquapendente, the remaining step might easily have been made by any person of common abilities. "This discovery (he observes) set Harvey to work upon the *use* of the heart and vascular system in animals: and in the course of some years, he was so happy as to discover, and to prove beyond all possibility of doubt, the circulation of the blood." He afterwards expresses his astonishment that this discovery should have been left for Harvey; adding, that "Providence meant to reserve it for *him*, and would not let men *see what was before them, nor understand what they read*." Hunter's Introductory Lectures, p. 42. et seq.

Whatever opinion be formed on this point. Dr. Hunter's remarks are valuable, as an additional proof of the regard paid by anatomists to *Final Causes*, in the study of physiology.

See also Haller, Elem. Physiolog. Tom. I. p. 204.

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* Inquiry into the Nature of the Human Soul, Vol. I. p. 136. (3d Ed.)

The following passage from an old English divine may be of use for the farther illustration of this argument. I quote it with the greater confidence, as I find that the most eminent and original physiologist of the present age (M. Cuvier) has been led, by his enlightened researches concerning the laws of the animal economy, into a train of thinking strikingly similar.

"Man is always mending and altering his works; but nature observes the same tenor, because her works are so perfect, that there is no place for amendments, nothing that can be reprehended. The most sagacious men in so many ages have not been able to find any flaw in these divinely contrived and formed machines; no blot or error in this great volume of the world, as if any thing had been an imperfect essay at the first; nothing that can be altered for the better; nothing but if it were altered would be marred. This could not have been, had man's body been the work of chance, and not counsel and providence. Why should there be constantly the same parts? Why should they retain constantly the same places? Nothing so contrary as constancy and chance. Should I see a man throw the same number a thousand times together upon but three dice, could you persuade me that this were accidental, and that there was no necessary cause for it? How much more incredible then is it, that constancy in such a variety, such a multiplicity of parts, should be the result of chance? Neither yet can these works be the effects of Necessity or Fate, for then there would be the same constancy observed in the smaller as well as in the larger parts and vessels; whereas *there* we see nature doth, as it were, sport itself, the minute ramifications of all the vessels, veins, arteries, and nerves, infinitely varying in individuals of the same species, so that they are not in any two alike." (Ray's Wisdom of God in the Creation.)

Nature, (says Cuvier) while confining herself strictly within those limits which the conditions necessary for existence prescribed to her, has yielded to her spontaneous fecundity wherever these conditions did not limit her operations; and without ever passing beyond the small number of combinations, that can be realized in the essential modifications of the important organs, she seems to have given full scope to her fancy, in filling up the

The study of comparative anatomy leads, at every step, so directly and so manifestly to the same conclusion, that even those physiologists who had nothing in view but the advancement of their own science, unanimously agree in recommending the dissection of animals of different kinds, as the most effectual of all helps for ascertaining the *functions* of the various organs in the human frame;—tacitly assuming as an incontrovertible truth, that in proportion to the variety of means by which the same effect is accomplished, the presumption increases, that this effect was an *end* in the contemplation of the artist. "The intention of nature (says one author) in the formation of the different parts, can nowhere be so well learned as from comparative anatomy; that is, if we would understand physiology, and reason on the functions of the animal economy, we must see how the same end is brought about in other species.—We must contemplate the part or organ in *different* animals; its shape, position, and connexion with the other parts; and observe what thence arises. If we find ONE COMMON EFFECT constantly produced, though in a very different way, we may safely conclude that this is the *use* or *function* of the part.—

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subordinate parts. With respect to these, it is not inquired, whether an individual form, whether a particular arrangement be necessary: it seems often not to have been asked, whether it be often useful, in order to reduce it to practice; it is sufficient that it be possible, that it destroy not the harmony of the whole. Accordingly, as we recede from the principal organs, and approach to those of less importance, the varieties in structure and appearance become more numerous; and when we arrive at the surface of the body, where the parts the least essential, and whose injuries are the least momentous, are necessarily placed, the number of varieties is so great, that the conjoined labours of naturalists have not yet been able to give us an adequate idea of them." (Leçons d'Anatomie Comparée.)

This reasoning can never betray us, if we are but sure of the facts."*

The celebrated Albinus expresses himself to the same purpose in his preface to Harvey's *Exercitatio de Motu Cordis.* "Incidenda autem animalia, quibus partes illæ quarum actiones quærimus eædem atque homini sunt, aut certe similes iis; ex quibus sine metu erroris judicare de illis hominis liceat. Quin et reliqua, si modo aliquam habeant ad hominem similitudinem, idonea sunt ad aliquod suppeditandum."

If Bacon had lived to read such testimonies as these in favour of the investigation of Final Causes; or had witnessed the discoveries to which it has led in the study of the animal economy, he would, I doubt not, have readily admitted, that it was not altogether uninteresting and unprofitable, even to the *physical* inquirer. Such, however, is the influence of an illustrious name, that, in direct opposition to the evidence of historical facts, the assertion of the complete *sterility* of all these speculations is, to the present day, repeated, with undiminished confidence, by writers of unquestionable learning and talents. In one of the most noted physiological works which have lately appeared on the Continent, Bacon's apothegm is cited more than once with unqualified approbation; although the author candidly owns, that it is difficult for the most *reserved* philosopher always to keep it steadily in view, in the course of his inquiries.†

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* Letter by an anonymous Correspondent, prefixed to Monro's *Comparative Anatomy.* London, 1744.

† "Je regarde, avec le grand Bacon, la philosophie des causes finales comme sterile: mais il est bien difficile à l'homme le plus réservé, de n'y

The prejudice against final causes, so generally avowed by the most eminent philosophers of France, during the eighteenth century, was first introduced into that country by Des Cartes. It must not, however, be imagined, that, in the mind of this great man, it arose from any bias towards atheism. On the contrary, he himself tells us, that his objection to the research of *uses* or *ends*, was founded entirely on the presumptuous confidence which it seemed to argue in the powers of human reason; as if it were conceivable, that the limited faculties of man could penetrate into the counsels of Divine wisdom. Of the existence of God he conceived that a demonstrative proof was afforded by the idea we are able to form of a Being infinitely perfect, and necessarily existing; and it has with some probability been conjectured, that it was his partiality to this new argument of his own, which led him to reject the reasonings of his predecessors in support of the same conclusion.*

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avoir jamais recours dans ses explications." (Rapports du Physique et du Moral de l'Homme. Par M. le Senateur Cabanis. Tome I. p. 352. Paris, 1805.)

[*] "Nullas unquam rationes circa res naturales *a fine* quam Deus aut natura in iis faciendis sibi proposuit desumemus; quia non tantum debemus nobis arrogare ut ejus consiliorum participes nos esse putemus." (Princip. Pars I. §. 28.) "Dum hæc perpendo attentius, occurrit primò non mihi esse mirandum si quædam a Deo fiant quorum rationes non intelligam; nec de ejus existentia ideo esse dubitandum, quod forte quædam alia esse experiar quæ quare, vel quomodo ab illo facta sint non comprehendo; cum enim jam sciam naturam meam esse valde infirmam et limitatam, Dei autem naturam esse immensam, incomprehensibilem, infinitam, ex hoc satis etiam scio innumerabilia illum posse quorum causas ignorem; *atque ob hanc unicam rationem totum illud causarum genus quod a fine peti solet in rebus physicis nullum usum habere existimo;* non enim absque temeritate me puto posse investigare fines Dei." (Meditatio Quarta.)

See Note (BB.)

To this objection of Des Cartes, an elaborate, and, in my opinion, a most satisfactory reply, is to be found in the works of Mr. Boyle. The principal scope of his essay may be collected from the following short extract.

"Suppose that a countryman, being in a clear day brought into the garden of some famous mathematician, should see there one of those curious gnomonic instruments, that show at once the place of the sun in the zodiac, his declination from the equator, the day of the month, the length of the day, &c. &c. It would indeed be presumption in him, being unacquainted both with the mathematical disciplines, and the several intentions of the artist, to pretend or think himself able to discover *all the ends* for which so curious and elaborate a piece was framed: but when he sees it furnished with a style, with horary lines and numbers, and in short with all the requisites of a sun-dial, and manifestly perceives the shadow to mark from time to time the hour of the day, it would be no more a presumption than an error in him to conclude, that (whatever other uses the instrument was fit or was designed for) it is a sun-dial, that was meant to show the hour of the day."*

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* In the same Essay, Mr. Boyle has offered some very judicious strictures on the abuses to which the research of final causes is liable, when incautiously and presumptuously pursued. An abstract of these, accompanied with a few illustrations from later writers, might form an interesting chapter in a treatise of inductive logic.

The subject has been since prosecuted with considerable ingenuity by Le Sage of Geneva, who has even attempted (and not altogether without success) to lay down logical rules for the investigation of *ends*. To this study, which he was anxious to form into a separate science, he gave the very ill chosen name of *Teleologie*; a name, if I am not mistaken, first sug-

With this opinion of Boyle that of Newton so entirely coincided, that (according to Maclaurin) he thought the consideration of final causes *essential* to true philosophy; and was accustomed to congratulate himself on the effect of his writings in reviving an attention to them, after the attempt of Des Cartes to discard them from physics. On this occasion, Maclaurin has remarked, "that, of all sort of causes, final causes are the most clearly placed in our view;—and that it is difficult to comprehend, why it should be thought arrogant to attend to the design and contrivance that is so evidently displayed in nature, and obvious to all men;—to maintain, for instance, that the eye was made for seeing, though we may not be able either to account mechanically for the refraction of light in its coats, or to explain how the image is propagated from the retina to the mind."*—It is Newton's own language, however, which alone can do justice to his sentiments on the present subject.

"The main business of natural philosophy is to argue from phenomena, without feigning hypotheses, and to deduce causes from effects till we come to the very first cause, which certainly is not mechanical; and not only to unfold the mechanism of the world, but chiefly to resolve these and such like questions: *Whence is it that Nature does nothing in vain; and whence arises all that order and beauty which we see in the world;—How came the bodies of animals to be contrived with so much art, and*

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gested by Wolfius.—For some valuable fragments of his intended work with respect to it, see the Account of his Life and Writings by his friend M Prévost. (Geneva, 1805.)

* Account of Newton's Philosophical Discoveries, Book I. Chap. II.

*for what ends were their several parts? Was the eye contrived without skill in optics, and the ear without knowledge of sounds?"**

In multiplying these quotations, I am well aware that authorities are not arguments; but when a prejudice to which authority alone has given currency is to be combated, what other refutation is likely to be effectual?

After all, it were to be wished that the scholastic phrase *final cause* could, without affectation, be dropped from our philosophical vocabulary; and some more unexceptionable mode of speaking substituted instead of it. In this elementary work, I have not presumed to lay aside entirely a form of expression consecrated in the writings of Newton, and of his most eminent followers; but I am fully sensible of its impropriety, and am not without hopes that I may contribute something to encourage the gradual disuse of it, by the indiscriminate employment of the words *ends* and *uses* to convey the same idea. Little more perhaps than the general adoption of one or other of these terms is necessary, to bring candid and reflecting minds to a uniformity of language as well as of sentiment on the point in question.

It was before observed, with respect to anatomists, that all of them, without exception, whether professedly friendly or hostile to the inquisition of final causes, concur in availing themselves of its guidance in their physiological researches. A similar remark will be found to apply to other classes of scientific inquirers. Whatever their speculative opinions may be, the moment their curiosity is fairly engaged in the pursuit of truth, either physical or moral, they involuntarily, and often perhaps unconsciously, submit their understandings to a logic borrowed neither from the schools of Aristotle nor of Bacon. The ethical system (for example) of those ancient philosophers who held that Virtue consists in following Nature, not only involves a recognition of final causes, but represents the study of them, in as far as regards the ends and destination of our own being, as the great business and duty of life.* The system too of those physicians who profess to follow Nature in the treatment of diseases, by watching and aiding her medicative powers, assumes the same doctrine as its fundamental principle. A still more remarkable illustration, however, of the influence which this species of evidence has over the belief, even when we are the least aware of its connexion with metaphysical conclusions, occurs in the history of the French Economical System. Of the comprehensive and elevated views which at first suggested it, the title of *Physiocratie*, by which it was early distinguished, affords a strong presumptive proof; and the same thing is more fully demonstrated, by the frequent recurrence made in it to the physical and moral laws of Nature, as the unerring standard which the legislator should keep in view in all his positive institutions.† I do not speak at present of the justness of these opinions. I wish only to remark, that, in the statement of them given by their original authors, it is taken for granted as a truth self-evident and indisputable, not merely that benevolent design is manifested in all the physical and moral arrangements connected with this globe, but that the study of these arrangements is indispensably necessary to lay a solid foundation for political science.

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* Newton's Optics, Query 28.

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* "Discite, O miseri, et causas cognoscite rerum,
Quid sumus, et quidnam victuri gignimur."

PERSIUS.

Εγω δε τι βȣλομαι· καταμαθειν την φυσιν, ϗ ταυτη επεσθαι.

EPICTET.

† "Ces lois forment ensemble ce qu'on appelle *la loi naturelle*. Tous les hommes et toutes les puissances humaines doivent être soumis à ces lois

The same principles appear to have led Mr. Smith into that train of thinking which gave birth to his inquiries concerning National Wealth. " Man (he observes in one of his oldest manuscripts now extant) is generally considered by statesmen and projectors as the materials of a sort of political mechanics. Projectors disturb Nature in the course of her operations in human affairs; and it requires no more than to let her alone, and give her fair play in the pursuit of her own designs."—And in another passage: " Little else is requisite to carry a state to the highest degree of opulence from the lowest barbarism, but peace, easy taxes, and a tolerable administration of justice; all the rest being brought about by the natural course of things. All governments which thwart this natural course; which force things into another channel; or which endeavour to arrest the progress of society at a particular point, are unnatural, and to support themselves

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souveraines, institutées par l'être supreme : elles sont immuables et irréfragables, et les meilleurs loix possibles; et par censéquent, la base du governement le plus parfait, et la régle fondamentale de toutes les loix positives; car les loix positives ne sont que des loix de manutention relatives à l'ordre naturel evidemment le plus avantageux au genre humain."

QUESNAY.

are obliged to be oppressive and tyrannical."* Various other passages of a similar import might be quoted, both from his Wealth of Nations, and from his Theory of Moral Sentiments.

This doctrine of Smith and Quesnay, which tends to simplify the theory of legislation, by exploding the policy of those complicated checks and restraints which swell the municipal codes of most nations, has now, I believe, become the prevailing creed of thinking men all over Europe; and, as commonly happens to prevailing creeds, has been pushed by many of its partizans far beyond the views and intentions of its original authors. Such too is the effect of fashion, on the one hand, and of obnoxious phrases on the other, that it has found some of its most zealous abettors and propagators among writers who would, without a moment's hesitation, have rejected, as puerile and superstitious, any reference to *final causes* in a philosophical discussion.

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* Biographical Memoirs of Smith, Robertson, and Reid, p. 100.

II.

Danger of confounding Final with Physical Causes in the Philosophy of the Human Mind.

Having said so much upon the research of Final Causes in *Physics properly so called*, I shall subjoin a few remarks on its application to the philosophy of the human mind;—a science in which the just rules of investigation are as yet far from being generally understood. Of this no stronger proof can be produced, than the confusion between final and efficient causes, which perpetually recurs in the writings of our latest and most eminent moralists. The same confusion, as I have already observed, prevailed in the *physical* reasonings of the Aristotelians; but, since the time of Bacon, has been so completely corrected, that, in the wildest theories of modern naturalists, hardly a vestige of it is to be traced.

To the logical error just mentioned it is owing, that so many false accounts have been given of the principles of human conduct or of the motives by which men are stimulated to action. When the general laws of our internal frame are attentively examined, they will be found to have for their object the happiness and improvement both of the individual and of society. This is their Final Cause, or the end for which we may presume they were destined by our Maker. But, in such cases, it seldom happens, that while Man is obeying the *active impulses* of his nature, he has any idea of the ultimate ends which he is promoting; or is able to calculate the remote effects of the movements which he impresses on the little wheels around him. These *active impulses*, therefore, may, in one sense, be considered as the *efficient causes* of his conduct; inasmuch as they are the means employed to determine him to particular pursuits and habits; and as they operate (in the *first* instance, at least,) without any reflection on his part on the purposes to which they are subservient. Philosophers, however, have in every age been extremely apt to conclude, when they had discovered the salutary tendency of any active principle, that it was from a sense or foreknowledge of this tendency that the principle derived its origin. Hence have arisen the theories which attempt to account for all our actions from self-love; and also those which would resolve the whole of morality, either into political views of general expediency, or into an enlightened regard to our own best interests.

I do not know of any author who has been so completely aware of this common error as Mr. Smith. In examining the principles connected with our moral constitution, he always treats separately of their *final causes*, and of the *mechanism* (as he calls it) by which nature accomplishes the effect; and he has even been at pains to point out to his successors the great importance of attending to the distinction between these two speculations—"In every part of the universe, we observe means adjusted with the nicest artifice to the ends which they are intended to produce; and in the mechanism of a plant or animal body, admire how every thing is contrived for advancing the two great purposes of nature, the support of the individual, and the propagation of the species. But in these, and in all such objects, we still distinguish the efficient from the final cause of their several motions and organizations. The digestion of the food, the circulation of the blood, and the secretion of the several juices which are drawn from it, are operations all of them necessary for the great purposes of animal life; yet we never endeavour to account for them from those purposes as from their efficient causes, nor imagine that the blood circulates, or the food digests of its own accord, and with a view or intention to the purposes of circulation or digestion. The wheels of the watch are all admirably adapted to the end for which it was made, the pointing of the hour. All their various motions conspire in the nicest manner to produce this effect. If they were endowed with a desire and intention to produce it, they could not do it better. Yet we never ascribe any such intention or desire to them, but to the watch-maker, and we know that they are put into motion by a spring, which intends the effect it produces as little as they do. But though, in accounting for the operations of bodies, we never fail to distinguish, in this manner, the efficient from the final cause, in accounting for those of the mind, we are apt to confound these two different things with one another. When, by natural principles, we are led to advance those ends which a refined and enlightened reason would recommend to us, we are very apt to impute to that reason, as to their efficient cause, the sentiments and actions by which we advance those ends, and to imagine that to be the wisdom of Man, which, in reality, is the wisdom of God. Upon a superficial view, this cause seems sufficient to produce the effects which are ascribed to it; and the system of Human Nature seems to be more simple and agreeable, when all its different operations are, in this manner, deduced from a single principle."*

These remarks apply with peculiar force to a theory of morals which has made much noise in our own times; —a theory which resolves the obligation of all the different virtues into a sense of their *utility*. At the time when Mr. Smith wrote, it had been recently brought into fashion by the ingenious and refined disquisitions of Mr. Hume; and there can be little doubt, that the foregoing strictures were meant by the author as an indirect refutation of his friend's doctrines.

The same theory (which is of a very ancient date†) has been since revived by Mr. Godwin, and by the excellent Dr. Paley. Widely as these two writers differ in the *source* whence they derive their rule of conduct, and the *sanctions* by which they enforce its observance, they are perfectly agreed about its paramount authority over every other principle of action. Whatever is *expedient* (says Dr. Paley) is *right*. It is the utility of any moral rule alone which constitutes the obligation of it‡. . . . . But then, it must be expedient *on the whole*, at the long run, in all its effects collateral and remote, as well as those which are immediate and direct; as it is obvious, that in computing consequences, it makes no difference in what way, or at what distance they ensue."§—Mr. Godwin has

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* Theory of Moral Sentiments, Vol. I. p. 216, et seq. 6th Edit.

† "Ipsa utilitas, justi prope mater et æqui." HORAT. Sat. Lib. I. 3.

‡ Principles of Moral and Political Philosophy, Vol. I. p. 70. (5th Edit.)

§ Ibid. p. 78.

In another part of his work, Dr. Paley explicitly asserts, that every

[illegible]

the natural world, it is easy for a philosopher to give a plausible explanation of all our duties from *one* principle; because the general tendency of all of them is to determine us to the same course of life. It does not, however, follow from this, that it is from such a comprehensive survey of the consequences of human conduct, that our ideas of right and wrong are derived: or that we are entitled, in particular cases, to form rules of action to ourselves, drawn from speculative conclusions concerning the *final causes* of our moral constitution. If it be true (as some theologians have presumed to assert) that benevolence is the sole principle of action in the Deity, we must suppose that the duties of veracity and justice were enjoined by him, *not* on account of their intrinsic rectitude, but of their utility: but still, with respect to man, these are sacred and indispensable laws—laws which he never transgresses without incurring the penalties of self-condemnation and remorse: And indeed if, without the guidance of any internal monitor, he were left to infer the duties incumbent on him from a calculation and comparison of remote effects, we may venture to affirm, that there would not be enough of virtue left in the world to hold society together.

To those who have been accustomed to reflect on the general analogy of the human constitution, and on the admirable adaptation of its various parts to that scene in which we are destined to act, this last consideration will, independently of any examination of the fact, suggest a very strong presumption *a priori* against the doctrine to which the foregoing remarks relate. For is it at all consonant with the other arrangements so wisely calculated for human happiness to suppose, that the conduct of such a fallible and short-sighted creature as Man, would be left to be regulated by no other principle than the private opinion of each individual concerning the *expediency* of his own actions? or, in other words, by the conjectures which he might form on the good or evil resulting *on the whole* from an endless train of future contingencies? Were this the case, the opinions of mankind with respect to the rules of morality would be as various as their judgments about the probable issue of the most doubtful and difficult determinations in politics. Numberless cases might be fancied, in which a person would not only *claim* merit but actually *possess* it, in consequence of actions which are generally regarded with indignation and abhorrence; for unless we admit such duties as justice, veracity, and gratitude, to be immediately and imperatively sanctioned by the authority of reason and of conscience, it follows as a necessary inference, that we are *bound* to violate them, whenever by doing so we have a prospect of advancing any of the essential interests of society; or (which amounts to the same thing) that a good *end* is sufficient to sanctify whatever *means* may appear to us to be necessary for its accomplishment. Even men of the soundest and most penetrating understandings might frequently be led to the perpetration of enormities, if they had no other light to guide them but what they derived from their own uncertain anticipations of futurity. And when we consider how small the number of such men is, in comparison of those whose judgments are perverted by the prejudices of education and their own selfish passions, it is easy to see what a scene of anarchy the world would become. Of this indeed we have too melancholy an experimental proof, in the history of those individuals who have in practice adopted the rule of *general expediency* as their whole code of morality;—a rule which the most execrable scourges of the human race have, in all ages, professed to follow, and of which they have uniformly availed themselves, as an apology for their deviations from the ordinary maxims of right and wrong.

Fortunately for mankind, the peace of society is not thus entrusted to accident, the great rules of a virtuous conduct being confessedly of such a nature as to be obvious to every sincere and well-disposed mind. And it is in a peculiar degree striking, that, while the *theory* of *ethics* involves some of the most abstruse questions which have ever employed the human faculties, the moral judgments and moral feelings of the most distant ages and nations, with respect to all the most essential duties of life, are one and the same.

Of this theory of utility, so strongly recommended to some by the powerful genius of Hume, and to others by the well-merited popularity of Paley, the most satisfactory of all refutations is to be found in the work of Mr. Godwin. It is unnecessary to inquire how far the practical lessons he has inculcated are logically inferred from his fundamental principle; for although I apprehend much might be objected to these, even on his own hypothesis, yet, if such be the conclusions to which, in the judgment of so acute a reasoner, it *appeared* to lead with demonstrative evidence, nothing farther is requisite to illustrate the practical tendency of a system, which, absolving men from the obligations imposed on them with so commanding an authority by the moral constitution of human nature, abandons every individual to the guidance of his own narrow views concerning the complicated interests of political society.*

One very obvious consideration seems to have entirely escaped the notice of this, as well as of many other late inquirers: That, in ethical researches, not less than in those which relate to the material universe, the business of the philosopher is limited to the analytical investigation of general laws from the observed phenomena; and that if, in any instance, his conclusions should be found inconsistent with acknowledged facts, the former must necessarily be corrected or modified by the latter. On such occasions, the ultimate appeal must be always made to the moral sentiments and emotions of the human race. The representations, for example, which we read with so much delight, in those poets, of whatever age and country, who have most successfully touched the human heart:—of the heroical sacrifices made to gratitude, to parental duty, to filial piety, to conjugal affection;—are not amenable to the authority of any ethical theory, but are the most authentic records of the phenomena which it is the object of such theories to generalize. The sentiment of Publius Syrus; *Omne dixeris maledictum, quum ingratum hominem dixeris*—speaks a language which accords with every feeling of an unperverted mind;—it speaks the language of Nature, which it is the province of the moralist, not to criticize, but to listen to with reverence. By employing our reason to interpret and to obey this, and the other moral suggestions of the heart, we may trust with confidence, that we take the most effectual means in our power to augment the sum of human happiness;—but the discovery of this connexion between *virtue* and *utility* is the slow result of extensive and philosophical combinations; and it would soon cease to have a foundation in truth, if men were to substitute their own conceptions of expediency, instead of those rules of action which are inspired by the wisdom of God.*

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* It is remarkable that Mr. Hume, by far the ablest advocate for the theory in question, has indirectly acknowledged its inconsistence with some of the most important facts which it professes to explain. "Though the *heart* (he observes in the 5th section of his Inquiry concerning Morals) takes not part entirely with those general notions, nor regulates all its love and hatred by the universal abstract differences of vice and virtue, without regard to self, and the persons with whom we are more intimately connected: yet have these moral differences a considerable influence, and being sufficient, at least for discourse, serve all the purposes in company, in the pulpit, on the theatre, and in the schools."—On this passage, the following very curious note is to be found at the end of the volume; a note (by the way) which deserves to be added to the other proofs already given of the irresistible influence which the doctrine of final causes occasionally exercises over the most sceptical minds. "*It is wisely ordained by nature* that private connexions should *commonly* prevail over universal views and considerations; otherwise our affections and actions would be dissipated and lost, for want of a proper limited object."—Does not this remark imply an acknowledgment, First, That the principle of general expediency (the *sole* principle of virtuous conduct, according to Mr. Hume, in our most important transactions with our fellow-creatures) would not contribute to the happiness of society, if men should *commonly* act upon it; and, Secondly, That some provision is made in our moral constitution, that we shall, in fact, be influenced by other motives in discharging the offices of private life?

It must not be concluded from the foregoing observations, that, even in ethical inquiries, the consideration of final causes is to be rejected. On the contrary, Mr. Smith himself, whose logical precepts on this subject I have now been endeavouring to illustrate and enforce, has frequently indulged his curiosity in speculations about *uses* or *advantages*; and seems plainly to have considered them as important objects of philosophical study, not less than *efficient* causes. The only caution to be observed is, that the one may not be confounded with the other.

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* See Note (CC.)

Between these two different researches, however, there is, both in physics and ethics, a very intimate connexion. In various cases, the consideration of final causes has led to the discovery of some general law of nature; and, in almost every case, the discovery of a general law clearly points out some wise and beneficent purposes to which it is subservient. Indeed it is chiefly the prospect of such applications which renders the investigation of general laws interesting to the mind.*

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* See Note (DD.)

CONCLUSION OF PART SECOND.

IN the foregoing chapters of this Second Part, I have endeavoured to turn the attention of my readers to various important questions relating to the Human Understanding; aiming, in the first place, to correct some fundamental errors in the theories commonly received with respect to the powers of intuition and of reasoning; and secondly, to illustrate some doctrines connected with the ground-work of the inductive logic, which have been either overlooked, or misapprehended by the generality of preceding writers. The bulk to which the volume has already extended, renders it impossible for me now to attempt a detailed recapitulation of its contents:—Nor do I much regret the necessity of this omission, having endeavoured, in every instance, as far as I could, to enable the intelligent reader to trace the thread of my discussions.

In a work professedly elementary, the frequent references made to the opinions of others may, at first sight, appear out of place; and it may not unnaturally be thought, that I have too often indulged in *critical* strictures, where I ought to have confined myself to a didactic exposition of first principles. To this objection I have only to reply, that my aim is not to supplant any of the established branches of academical study; but by inviting and encouraging the young philosopher, when his academical career is closed, to review with attention and candour, his past acquisitions, to put him in the way of supplying what is defective in the present systems of education. I have accordingly entitled my book, Elements—not of Logic or of Pneumatology, but—of the Philosophy of the Human Mind; a study which, according to my idea of it, presupposes a general acquaintance with the particular departments of literature and of science, but to which I do not know that any elementary introduction has yet been attempted. It is a study, indeed, whereof little more perhaps than *the elements* can be communicated by the mind of one individual to that of another.

In proof of this, it is sufficient here to hint, (for I must not at present enlarge on so extensive a topic,) that a knowledge of the general laws which regulate the intellectual phenomena is, to the logical student, of little practical value, but as a preparation for the study of himself. In this respect, the anatomy of the mind differs essentially from that of the body; the structure of the former (whatever collateral aids may be derived from observing the varieties of genius in our fellow-creatures) being accessible to those alone who can retire into the deepest recesses of their own internal frame; and even to *these* presenting, along with the generic attributes of the race, many of the specific peculiarities of the individual. The truth is, that on this subject every writer, whose speculations are at all worthy of notice, must draw his chief materials from within; and that it is only by comparing the conclusions of *different* writers, and subjecting all of them to the test of our personal experience, that we can hope to separate the essential principles of the human constitution from the unsuspected effects of education and of temperament;*

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* I use the word *temperament*, in this instance, as synonymous with the *idiosyncrasy* of medical authors; a term which I thought might have

or to apply with advantage, to our particular circumstances, the combined results of our reading and of our reflections. The constant appeal which, in such inquiries, the reader is thus forced to make to his own consciousness and to his own judgment, has a powerful tendency to form a habit, not more essential to the success of his metaphysical researches, than of all his other speculative pursuits.

Nearly connected with this habit, is a propensity to weigh and to ascertain the exact import of words; one of the nicest and most difficult of all analytical processes; and *that* upon which more stress has been justly laid by our best modern logicians, than upon any other *organ* for the investigation of truth. For the culture of this propensity, no science is so peculiarly calculated to prepare the mind, as the study of its own operations. *Here*, the imperfections of words constitute the principal obstacle to our progress: nor is it possible to advance a single step, without struggling against the associations imposed by the illusions of metaphorical terms, and of analogical theories. Abstracting, therefore, from its various practical applications, and considering it merely as a gymnastic exercise to the reasoning powers, this study seems pointed out by nature, as the best of all schools for inuring the understanding to a cautious and skilful employment of language as the instrument of thought.

The two first chapters of this volume relate to logical questions, on which the established opinions appear to me

savoured of affectation if applied to *the mind;* although authorities for such an employment of it are not wanting among old English writers. One example, directly in point, is quoted by Johnson from Glanville. "The understanding also hath its *idiosyncracies*, as well as other faculties."

to present stumbling-blocks at the very threshold of the science. In treating of these, I have canvassed with freedom, but, I hope, with due respect, the doctrines of some illustrious moderns, whom I am proud to acknowledge as my masters; of those more particularly, whose works are in the highest repute in our British Universities, and whose errors I was, on that account, the most solicitous to rectify. For the space allotted to my criticisms on Condillac, no apology is necessary to those, who have the slightest acquaintance with the present state of philosophy on the Continent, or who have remarked the growing spread, in this Island, of some of his weakest and most exceptionable theories.—On various controverted points connected with the theory of evidence, both demonstrative and experimental, I trust, with some confidence, that I shall be found to have thrown considerable light: in other instances, I have been forced to content myself with proposing my doubts; leaving the task of solving them to future inquirers. To awaken a dormant spirit of discussion, by pointing out the imperfections of accredited systems, is at least one step gained towards the farther advancement of knowledge.

It is justly and philosophically remarked by Burke, that "nothing tends more to the corruption of science than to suffer it to stagnate. These waters must be troubled before they can exert their virtues. A man who works beyond the surface of things, though he may be wrong himself, yet he clears the way for others, and may chance to make even his errors subservient to the cause of truth."*

* Inquiry into the Sublime and Beautiful, Part I. Sect. xix.

The subsequent chapters, relative to the Baconian Logic, bear, all of them, more or less in their general scope, on the theory of the intellectual powers, and on the first principles of human knowledge. In this part of my work, the reader will easily perceive, that I do not profess to deliver logical precepts; but to concentrate, and to reflect back on the Philosophy of the Mind, whatever scattered lights I have been able to collect from the experimental researches to which that Philosophy has given birth. I have aimed, at the same time (and I hope not altogether without success) to give somewhat more of precision to the technical phraseology of the Baconian school, and of correctness to their metaphysical ideas.

Before concluding these speculations, it may not be improper to caution my readers against supposing, that when I speak of the Baconian school, or of the Baconian logic, I mean to ascribe entirely to the *Novum Organon* the advances made in physical science, since the period of its publication. The singular effects of this, and of the other inestimable writings of the same author, in forwarding the subsequent progress of scientific discovery, certainly entitle his name, far more than that of any other individual, to be applied as a distinguishing epithet to the modern rules of philosophizing; but (as I have elsewhere observed) "the genius and writings of Bacon himself were powerfully influenced by the circumstances and character of his age: Nor can there be a doubt, that he only accelerated a revolution which was already prepared by many concurrent causes."*—My reasons for thinking so, which rest chiefly on historical retrospects, altogether foreign to my present design, I must delay stating, till another opportunity.

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* Outlines of Moral Philosophy, first printed in 1793.

To this observation it is of still greater importance to add, that, in contrasting the spirit and the utility of the new logic with those of the old, I have no wish to see the former substituted, in our universities, in room of the latter. By a strange inversion in the order of instruction, Logic, instead of occupying its natural place at the close of the academical course, has always been considered as an introduction to the study of the sciences; and has, accordingly, been obtruded on the uninformed minds of youth, at their first entrance into the schools. While the syllogistic art maintained its reputation, this inversion was probably attended with little practical inconvenience; the trite and puerile examples commonly resorted to for the illustration of its rules, presupposing a very slender stock of scientific attainments; but now, when the word Logic is universally understood in a more extensive sense, as comprehending, along with an outline of Aristotle's *Organon*, some account of the doctrines of Bacon, of Locke, and of their successors, it seems indispensably necessary, that this branch of education should be delayed till the understanding has acquired a wider and more varied range of ideas, and till the power of *reflection* (the last of our faculties which nature unfolds) begins to solicit its appropriate nourishment. What notions can be annexed to such words as analysis, synthesis, induction, experience, analogy, hypothetical and legitimate theories, demonstrative and moral certainty, by those whose attention has hitherto been exclusively devoted to the pursuits of classical learning? A fluent command, indeed, of this technical phraseology may be easily communicated; but it would be difficult to devise a more effectual expedient for misleading, at the very outset of life, the inexperienced and unassured judgment. The perusal of Bacon's writings, in particular, disfigured as they are by the frequent use of quaint and barbarous expressions, suited to the scholastic taste of his contemporaries, ought to be carefully reserved for a riper age.*

In confirmation of this last remark, many additional arguments might be drawn from the peculiar circumstances in which Bacon wrote. At the period when he entered on his literary career, various branches of physical science were already beginning to exhibit the most favourable presages of future improvement; strongly inviting his original and powerful mind to co-operate in the reformation of philosophy. The turn of his genius fortunately led him to employ himself chiefly in general suggestions for the advancement of learning; and, leaving to others the task of inductive investigation, to aim rather at stating such rules as might direct and systematize their exertions.

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* Haller mentions, in his Elements of Physiology, that he was forced to enter on the study of logic in the tenth year of his age. "Memini me annum natum decimum, quo avidus historiam et poesin devorassem, ad logicam, et ad CLAUBERGIANAM logicam ediscendam coactum fuisse, quâ nihil poterat esse, pro hujusmodi homuncione, sterilius." (Tomus VIII. Pars Secunda, p. 24. Lausannæ, 1778.) It seems difficult to imagine any attempt more extravagant, than that of instructing a child, only ten years old, in the logic of the schools; and yet it is by no means a task so completely impracticable, as to convey to a pupil, altogether uninitiated in the Elements of Physics, a distinct idea of the object and rules of the Novum Organon.

The example of Mr. Smith, during the short time he held the Professorship of Logic, at Glasgow, is worthy of imitation in those universities which admit of similar deviations from old practices. For an account of his plan, see Biographical Memoirs of Smith, Robertson, and Reid, p. 12; where I have inserted a slight but masterly sketch of his academical labours, communicated to me by his pupil and friend, the late Mr. Millar.

In his own experimental researches he was not very fortunate; nor is much reliance to be placed on the facts recorded in his *Histories*. Perhaps the comprehensiveness of his views diminished his curiosity with respect to the particular objects of science; or, perhaps, he found the multiplicity of his engagements in active life, more consistent with speculations, in which the chief materials of his reasonings were to be drawn from his own reflections, than with inquiries which demanded an accurate observation of external phenomena, or a minute attention to experimental processes. In this respect, he has been compared to the Legislator of the Jews, who conducted his followers within sight of their destined inheritance; and enjoyed, in distant prospect, that promised land which he himself was not permitted to enter.*

The effect of this prophetic imagination in clothing his ideas, to a greater degree than a severe logician may approve, with the glowing colours of a poetical diction, was unavoidable. The wonder is, that his style is so seldom chargeable with vagueness and obscurity; and that he has been able to bequeath to posterity so many cardinal and eternal truths, to which the progressive light of science is every day adding a new accession of lustre. Of these truths, however, (invaluable in themselves as heads or texts, pregnant with thought) many,—to borrow the expression of a Greek poet,—*sound only to the intelligent;* while others present those confident but indefinite anticipations of intellectual regions yet undiscovered, which, though admirably calculated to keep alive and to nourish the ardour of the man of science, are more fitted to awaken the enthusiasm, than to direct the studies of youth. Some of them, at the same time (and *these*, I apprehend, cannot be too early impressed on the memory) are singularly adapted to enlarge and to elevate the conceptions; exhibiting those magnificent views of knowledge which, by identifying its progress with the enlargement of human power and of human happiness, ennoble the humblest exertions of literary industry, and annihilate, before the triumphs of genius, the most dazzling objects of vulgar ambition.—A judicious selection of such passages, and of some general and striking aphorisms from the Novum Organon, would form a useful manual for animating the academical tasks of the student; and for gradually conducting him from the level of the subordinate sciences, to the *vantage-ground* of a higher philosophy.

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* See Cowley's Ode, prefixed to Sprat's History of the Royal Society.

"In rebus quibuscunque difficilioribus, non expectandum est ut quis simul et serat et metat; sed præparatione opus est, ut per gradus maturescant." BACON.

Unwilling as I am to touch on a topic so hopeless as that of Academical Reform, I cannot dismiss this subject, without remarking, as a *fact* which at some future period will figure in literary history, that two hundred years after the date of Bacon's philosophical works, the antiquated routine of study, originally prescribed in times of scholastic barbarism and of popish superstition, should, in so many Universities, be still suffered to stand in the way of improvements, recommended at once by the present state of the sciences, and by the order which nature follows in developing the intellectual faculties. On this subject, however, I forbear to enlarge.—Obstacles of which I am not aware may perhaps render any considerable innovations impracticable; and, in the meantime, it would be vain to speculate on ideal projects, while the prospect of realizing them is so distant and uncertain.

NOTES AND ILLUSTRATIONS.

Note (A.) p. 37.

OF the fault in Euclid's arrangement which I have here remarked, some of the ancient editors were plainly aware, as they removed the two *theorems* in question from the class of axioms, and placed them, with at least an equal impropriety, in that of postulates. "In quibusdam codicibus (says Dr. Gregory) Axiomata 10 et 11 inter postulata numerantur." (Euclidis quæ supersunt omnia. Ex Recens. Dav. Gregorii. Oxon. 1703. p. 3.)

The 8th Axiom too in Euclid's enumeration is evidently out of its proper place. Και τα εφαρμοζοντα επ' αλληλα ισα αλληλοις εστι:—thus translated by Dr. Simson: "Magnitudes which coincide with one another, that is, which exactly fill the same space, are equal to one another." This, in truth, is not an axiom, but a definition. It is the definition of geometrical equality; the fundamental principle upon which the comparison of all geometrical magnitudes will be found ultimately to depend.

For *some* of these slight logical defects in the arrangement of Euclid's definitions and axioms, an ingenious, and, I think, a solid apology, has been offered by M. Prévost, in his *Essais de Philosophie*. According to this author (if I rightly understand his meaning) Euclid was himself fully aware of the objections to which this part of his work is liable; but found it impossible to obviate them, without incurring the still greater inconvenience of either departing from those modes of proof which he had resolved to employ exclusively in the composition of his Elements;* or of revolting the student, at his first outset, by prolix and circuitous demonstrations of manifest and indisputable truths. I shall distinguish by Italics, in the following quotation, the clauses to which I wish more particularly to direct the attention of my readers.

"C'est donc l'imperfection (peut-être inévitable) de nos conceptions, qui a engagé à faire entrer les axiomes pour quelque chose dans les principes des sciences de raisonnement pur. Et ils y font un double office. Les uns remplacent des définitions. Les autres remplacent des propositions susceptibles d'être démontrées. J'en donnerai des examples tirées des Elémens d'Euclide.

"Les axiomes remplacent quelquefois des definitions très faciles à faire, comme celle du mot *tout*. (El. Ax. 9.) *D'autres supplécnt à certaines définitions difficiles et qu'on évite, comme celles de la ligne droite et de l'angle.*

"Quelques axiomes remplacent des théorèmes. J'ignore si (dans les principes d'Euclide) l'axiome 11. peut-être démontré (comme l'ont cru Proclus et tant d'autres anciens et modernes.) *S'il peut l'être, cet axiome supplée à une démonstration probablement laborieuse.*

"Puisque les axiomes ne font autre office que suppléer à des definitions et à des théorèmes, on demandera peut-être qu'on s'en passe. Observons 1. *Qu'ils evitent souvent des longueurs inutiles.* 2. *Qu'ils tranchent les disputes à l'epoque même ou la science est imparfaite.* 3. *Que s'il est un état, auquel la science puisse s'en passer (ce que je n'affirme point) il est du moins sage, et même indispensable, de les employer, tant que quelque insuffisance, dans ce degré de perfection où l'on tend, interdit un ordre absolument irréprochable.* Ajoutons 4. Que dans chaque science il y a ordinairement un principe qu'on pourroit appeller dominant, et qui par cette raison seule (et indépendamment de celles que je viens d'alléguer) a paru devoir être sorti, pour ainsi dire, du champ des définitions pour être mis en vue sous forme d'axiome. Tel me paroit être en géométrie le principe de congruence contenu dans le 8 Axiome d'Euclide." (Essais de Philosophie, Tom. II. pp. 30, 31, 32.)

These remarks go far, in my opinion, towards a justification of Euclid for the latitude with which he has used the word axiom in his Elements. As in treating, however, of the fundamental laws of human belief, the utmost possible precision of language is indispensably necessary, I must beg leave once more to remind my readers, that, in denying *Axioms* to be the first principles of reasoning in mathematics, I restrict the meaning of that word to such as are analogous to the first seven in Euclid's list. Locke, in what he has written on the subject, has plainly understood the word in the same limited sense.

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* By introducing, for example, the idea of *Motion*, which he has studied to avoid, as much as possible, in delivering the Elements of Plane Geometry.

Note (B.) p. 67.

The prevalence in India of an opinion bearing *some* resemblance to the Berkeleian Theory may be urged as an objection to the reasoning in the text; but the fact is, that this resemblance is much slighter than has been generally apprehended. (See Philosophical Essays, pp. 81, 82, et seq.) On this point the following passage from Sir William Jones is decisive; and the more so, that he himself has fallen into the common mistake of identifying the Hindu belief with the conclusions of Berkeley and Hume.

"The fundamental tenet of the *Vĕdánti* school consisted, *not in denying the existence of matter, that is, of solidity, impenetrability, and extended figure, (to deny which would be lunacy,) but in correcting the popular notion of it,* and in contending, that it has no essence independent of mental perception, that existence and perceptibility are convertible terms, that external appearances and sensations are illusory, and *would vanish into nothing, if the divine energy, which alone sustains them, were suspended but for a moment;** an opinion, which Epicharmus and Plato seem to have adopted, and which has been maintained in the present century with great elegance, but with little public applause; partly because it has been misunderstood, and partly because it has been misapplied by the false reasoning of some unpopular writers, who are said to have disbelieved in the moral attributes of God, whose omnipresence, wisdom, and goodness, are the basis of the Indian philosophy. I have not sufficient evidence on the subject to profess a belief in the doctrine of the *Védánta*, which human reason alone could, perhaps, neither fully demonstrate, nor fully disprove; but it is manifest, that nothing can be farther removed from impiety than a system wholly built on the purest devotion." (Works of Sir William Jones, Vol. I. pp. 165, 166.)

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* Sir William Jones here evidently confounds the system which represents the material universe as not only at first *created*, but as every moment *upheld* by the agency of Divine Power, with that of Berkeley and Hume, which, denying the distinction between primary and secondary qualities, asserts, that extension, figure, and impenetrability are not less inconceivable, without a *percipient* mind, than our sensations of heat and cold, sounds and odours. According to both systems, it may undoubtedly be said, that the material universe has no existence independent of *mind;* but it ought not to be overlooked, that in the *one*, this word refers to the Creator, and in the *other*, to the created percipient.

From these observations (in some of which, I must be permitted to say, there is a good deal of indistinctness, and even of contradiction,) it may on the whole be inferred, 1. That in the tenets of the Vedanti school, however different from the first apprehensions of the unreflecting mind, there was nothing *inconsistent* with the fundamental laws of human belief, any more than in the doctrine of Copernicus concerning the earth's motion. 2. That these tenets were rather articles of a theological creed, than of a philosophical system; or at least, that the two were so blended together, as sufficiently to account for the hold which, independently of any refined reasoning, they had taken of the popular belief.

In this last conclusion I am strongly confirmed, by a letter which I had the pleasure of receiving, a few years ago, from my friend Sir James Mackintosh, then Recorder of Bombay. His good nature will, I trust, pardon the liberty I take in mentioning his name upon the present occasion, as I wish to add to the following very curious extract, the authority of so enlightened and philosophical an observer. Amidst the variety of his other important engagements, it is to be hoped that the results of his literary researches and speculations, while in the East, will not be lost to the world.

. . . . . "I had yesterday a conversation with a young Bramin of no great learning, the son of the Pundit (or assessor for Hindu law) of my court. He told me, that besides the myriads of gods whom their creed admits, there was one whom they know by the name of BRIM, or the great one, without form or limits, whom no created intellect could make any approach towards conceiving; that, in reality, there were no trees, no houses, no land, no sea, but all without was Maia, or illusion, the act of BRIM; that whatever we saw or felt was only a dream, or, as he expressed it in his imperfect English, thinking in one's sleep, and that the reunion of the soul to BRIM, from whom it originally sprung, was the awakening from the long sleep of finite existence. All this you have heard and read before as Hindu speculation. What struck me was, that speculations so refined and abstruse should, in a long course of ages, have fallen through so great a space as that which separates the genius of their original inventor from the mind of this weak and unlettered man. The names of these inventors have perished; but their ingenious and beautiful theories, blended with the most monstrous superstitions, have descended to men very little exalted above the most ignorant populace, and are adopted by them as a sort of articles of faith, without a suspicion of their philosophical origin, and without the possibility of comprehending any part of the premises from which they were deduced. I intend to investigate a little the history of these opinions, for I am not altogether without apprehension, that we may all the while be mistaking the hyperbolical effusions of mystical piety, for the technical language of a philosophical system. Nothing is more usual, than for fervent devotion to dwell so long and so warmly on the meanness and worthlessness of created things, and on the all-sufficiency of the Supreme Being, that it slides insensibly from comparative to absolute language, and, in the eagerness of its zeal to magnify the Deity, seems to *annihilate* every thing else. To distinguish between the very different import of the same words in the mouth of a mystic and of a sceptic, requires more philosophical discrimination than most of our Sanscrit investigators have hitherto shown."

Note (C.) p. 82.

The private correspondence here alluded to, was between Mr. Hume and the late Sir Gilbert Elliott; a gentleman who seems to have united, with his other well-known talents and accomplishments, a taste for abstract disquisitions, which rarely occurs in men of the world; accompanied with that soundness and temperance of judgment which, in such researches, are so indispensably necessary to guard the mind against the illusions engendered by its own subtilty. In one of his letters (of which the original draft in his own hand-writing was communicated to me by the Earl of Minto) he expresses himself thus:[*]

. . . "I admit, that there is no writing or talking of any subject which is of importance enough to become the object of reasoning, without having recourse to some degree of subtilty and refinement. The only question is, where to stop, how far we can go, and why no farther? To this question I should be extremely happy to receive a satisfactory answer. I can't tell if I shall rightly express what I have just now in my mind; but I often imagine to myself, that I perceive within me a certain instinctive feeling, which shoves away at once all over subtile refinements, and tells me, with authority, that these air-built notions are inconsistent with life and experience, and by consequence cannot be true or solid. From this I am led to think, that the speculative principles of our nature ought to go hand in hand with the practical ones; and, for my own part, when the former are so far pushed, as to leave the latter quite out of sight, I am always apt to suspect that we have transgressed our limits. If it should be asked, how far will these practical principles go? I can only answer, that the former difficulty will recur, unless it be found, that there is *something* in the intellectual part of our nature, resembling the moral sentiment in the moral part of our nature, which determines this, as it were, instinctively. Very possibly, I have wrote nonsense: however, this notion first occurred to me at London, in conversation with a man of some depth of thinking; and talking of it since to your friend Henry Home,[†] I found that he seemed to entertain some notions nearly of the same kind, and to have pushed them much farther."

The *practical principles* referred to in this extract, seem to me to correspond very nearly with what I have called *fundamental laws of belief*, or *first elements of human reason;* and the SOMETHING *in the intellectual part of our nature, resembling the moral sentiment in the moral part of our nature*, is plainly descriptive of what Reid and others have since called *common sense;* coinciding, too, in substance with the philosophy of Lord

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[*] The letter is dated in 1751.

[†] Afterwards Lord Kames.

Kames, who refers our belief of the existence of the Deity, and of various other primary truths, to particular *senses*, forming a constituent part of our intellectual frame. I do not take upon me to defend the forms of expression which Mr. Hume's very ingenious correspondent has employed to convey his ideas; and which, it is probable, he did not think it necessary for him, in addressing a confidential friend, to weigh with critical exactness: but his doctrine must be allowed to approximate remarkably to those parts of the works of Reid, where he appeals from the paradoxical conclusions of metaphysicians, to the principles on which men are compelled, by the constitution of their nature, to judge and to act in the ordinary concerns of life;—as well as to various appeals of the same kind, which occur in Lord Kames's writings. My principal object, however, in introducing it here, was to show, that this doctrine was the natural result of the state of science at the period when Reid appeared; and consequently, that no argument against his originality in adopting it can reasonably be founded on a coincidence between his views concerning it and those of any preceding author.

Of Mr. Hume's respect for the literary attainments of this correspondent, so strong a proof occurs in a letter, (dated Ninewells, March 10, 1751,) that I am tempted to subjoin to the foregoing quotation the passage to which I allude.

"You would perceive, by the sample I have given you, that I make Cleanthes the hero of the dialogue. Whatever you can think of to strengthen that side of the argument, will be most acceptable to me. Any propensity you imagine I have to the other side crept in upon me against my will; and 'tis not long ago that I burned an old manuscript book, wrote before I was twenty, which contained, page after page, the gradual progress of my thoughts on that head. It began with an anxious search after arguments to confirm the common opinion: Doubts stole in,—dissipated,—returned,—were again dissipated,—returned again: And it was a perpetual struggle of a restless imagination against inclination, perhaps against reason.

"I have often thought, that the best way of composing a dialogue would be, for two persons that are of different opinions about any question of importance, to write alternately the different parts of the discourse, and reply to each other. By this means that vulgar error would be avoided, of putting nothing but nonsense into the mouth of the adversary; and, at the same time, a variety of character and genius being upheld, would make the whole look more natural and unaffected. Had it been my good fortune to live near you, I should have taken upon me the character of Philo in the dialogue, which you'll own I could have supported naturally enough: and you would not have been averse to that of Cleanthes." . . . . .

In a postscript to this letter, Mr. Hume recurs to the same idea. "If you'll be persuaded to assist me in supporting Cleanthes, I fancy you need not take the matter any higher than Part 3. He allows, indeed, in Part 2d, that all our inference is founded on the similitude of the works of nature to the usual effects of mind: otherwise they must appear a mere chaos. The only difficulty is, why the other dissimilitudes do not weaken the argument: And, indeed, it would seem from experience and feeling, that they do not weaken it so much as we might reasonably expect. A theory to solve this would be very acceptable."*

Note (D.) p. 86.

It would perhaps be difficult to mention another phrase in our language, which admits of so great a variety of interpretations as *common sense;* and to which, of consequence, it could have been equally dangerous to annex a new technical meaning in stating a controversial argument. Dr. Beattie has enumerated some of these in the beginning of his Essay, but he has by no means exhausted the subject: nor is his enumeration altogether unexceptionable in point of logical distinctness. On this point, however, I must allow my readers to judge for themselves. (See Essay on the Nature and Immutability of Truth, p. 37 et seq. 2d Edit.)

The Latin phrase *sensus communis* has also been used with much latitude. In various passages of Cicero it may be perfectly translated by the English phrase *common sense;* and, in the same acceptation, it is often employed in modern latinity. Of this (not to mention other authorities) many examples occur in the *Lectiones Mathematicæ* of Dr. Barrow; a work not more distinguished by originality and depth of thought, than by a logical precision of expression. In one of these, he appeals to *common sense* (*sensus communis*,) in proof of the circumference of the circle being less than the perimeter of the circumscribed square. (Lect. 1.)

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* From the above quotations it appears, that Mr. Hume's posthumous work, entitled Dialogues concerning Natural Religion, was projected, and, in part, at least, executed, twenty-five years before his death.

On other occasions, the *sensus communis* of classical writers plainly means something widely different; as in those noted lines of Juvenal, so ingeniously illustrated by Lord Shaftesbury, in his Essay on the Freedom of Wit and Humour.

> " Hæc satis ad juvenem, quem nobis fama superbum
> Tradit, et inflatum, plenumque Nerone propinquo.
> Rarus enim ferme *sensus communis* in illâ
> Fortunâ."

" Some commentators (says Shaftesbury) interpret this very differently from what is generally apprehended. They make this *common sense* of the poet, by a Greek derivation, to signify sense of public weal, and of the common interest; love of the community or society, natural affection, humanity, obligingness, or that sort of civility which rises from a just sense of the common rights of mankind, and the natural equality there is among those of the same species.

" And indeed if we consider the thing nicely, it must seem somewhat hard in the poet to have deny'd wit or ability to a court such as that of Rome, even under a Tiberius or a Nero. But for humanity or sense of public good, and the common interest of mankind, 'twas no such deep satire to question whether this was properly the spirit of a court. 'Twas difficult to apprehend what community subsisted among courtiers; or what Public among an absolute Prince and his slave-subjects. And for real *society*, there could be none between such as had no other *sense* than that of private good.

" Our poet, therefore, seems not so immoderate in his censure; if we consider it is the *heart*, rather than the *head*, he takes to task: when reflecting on a court education, he thinks it unapt to raise any affection towards a country; and looks upon young Princes and Lords as the *young masters* of the world; who, being indulged in all their passions, and trained up in all manner of licentiousness, have that thorough contempt and disregard of Mankind, which Mankind in a manner deserves, where arbitrary power is permitted, and a tyranny adored."

While I entirely agree with the general scope of these observations, I am inclined to think, that the *sensus communis* of Juvenal might be still more precisely rendered by *sympathy;* understanding this word (in the appropriate acceptation annexed to it by Mr. Smith) as synonymous with that fellow-feeling which disposes a man, in the discharge of his social duties, to place himself in the situation of others, and to regulate his conduct accordingly. Upon this supposition, the reflection in question coincides nearly with one of Mr. Smith's own maxims, that "the great *never* look upon their inferiors as their fellow-creatures;"* a maxim which, although sufficiently founded in fact to justify the sarcasm of the satirical poet, must (it is to be hoped for the honour of human nature) be understood with considerable limitations, when stated as a correct enunciation of philosophical truth.

It yet remains for me to take some notice of the *sensus communis* of the schoolmen; an expression which is perfectly synonymous with the word *conception*, as defined in the first volume of this work. It denotes the power whereby the mind is enabled to *represent* to itself any absent object of perception, or any sensation which it has formerly experienced. Its *seat* was supposed to be that part of the brain (hence called the *sensorium*, or the *sensorium commune*) where the nerves from all the organs of perception terminate. Of the peculiar function allotted to it in the scale of our intellectual faculties, the following account is given by Hobbes. "Some say the senses receive the species of things, and deliver them to the Common Sense; and the Common Sense delivers them over to the Fancy; and the Fancy to the Memory, and the Memory to the Judgment; like handling of things from one to another, with many words making nothing understood." (Of Man, Part I. Chap. 2.)

Sir John Davis, in his poem on the Immortality of the Soul, (published in the reign of Queen Elizabeth) gives the name of *common sense* to the power of *imagination;* (See Sections XIX. and XX.) and the very same phraseology occurs, at a later period, in the Philosophy of Des Cartes; (see, in particular, his Second Meditation, where he uses *Sensus Communis* as synonymous with *Potentia Imaginatrix*.) Both of these writers, as appears evidently from the context, understand by *Imagination* what I have called *Conception*. To the power *now* denoted by the word *Imagination*, Sir John Davis gives the name of *Fantasy*. Gassendi seems disposed to consider this use of the phrase *Sensus Communis* as an innovation of Des Cartes, (see his Objections to Des Cartes' Second Meditation, § 6.) but it had been previously adopted by various philosophical writers; and, in the English schools, was at that time familiar to every ear.

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* Theory of Moral Sentiments, Vol. I. p. 136, 6th Edit.

The singular variety of acceptations of which this phrase is susceptible; and the figure which, on different occasions, it has made in the history of philosophy, will, I trust, furnish a sufficient apology for the length as well as for the miscellaneous nature of the foregoing remarks.*

Note (E.) p. 97.

The Arithmetical Prodigy, alluded to in the text, is an American boy, (still, I believe, in London,) of whose astonishing powers in performing, by a mental process, hitherto unexplained, the most difficult numerical operations, some accounts have lately appeared in various literary journals. When the sheet containing the reference to this note was thrown off, I entertained the hope of having an opportunity, before reaching the end of the volume, to ascertain, by personal observation, some particulars with respect to him, which I thought might throw light on my conclusions concerning the faculty of Attention, in the former volume of this work. In this expectation, however,

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* It has been observed to me very lately by a learned and ingenious friend, that in one of the phrases which I have proposed to substitute for the *common sense* of Buffier and Reid, I have been anticipated, two hundred years ago, by Sir Walter Raleigh. "Where natural reason hath built any thing so strong against itself, as the same reason can hardly assail it, much less batter it down; the same, in every question of nature, and infinite power, may be approved for a *fundamental law of human knowledge*." (Preface to Raleigh's History of the World.) The coincidence in point of *expression*, is not a little curious; but is much less wonderful than the coincidence of the *thought* with the soundest logical conclusions of the eighteenth century.—The very eloquent and philosophical passage which immediately follows the above sentence, is not less worthy of attention.

I have been disappointed; and have, therefore, only to apologize for having inadvertently excited a curiosity which I am at present unable to gratify.

Note (F.) p. 159.

Εν τουτοις ἡ ισοτης ἑνοτης. "In mathematical quantities, equality is identity." (Arist. Met. x. c. 3.)

This passage has furnished to Dr. Gillies (when treating of the theory of syllogysms,) the subject of the following comment, in which, if I do not greatly deceive myself, he has proceeded upon a total misapprehension of the scope of the original. "In mathematical quantities, (Aristotle says, that) equality is sameness," because *ὁ λογος ὁ της πρωτης ουσιας ἑις εστι.* "The definition of any particular object denoted by the one is precisely the same with the definition of any particular object, denoted by the other." (Gillies's Aristotle, Vol. I. p. 87.)

In order to enable my readers to form a judgment of the correctness of this paraphrase, I must quote Aristotle's words, according to his own arrangement, which, in this instance, happens to be directly contrary to that adopted by his interpreter. *Ετι δε αν ὁ λογος ὁ της πρωτης ουσιας εἱς ῃ, οἱον αἱ ισαι γραμμαι ευθειαι αἱ αυται, ϗ τα ισα ϗ τα ισογωνια τετραγωνα, και τοι πλειω. αλλ' εν τουτοις ἡ ισοτης ἑνοτης.* The first clause of this passage is, from its conciseness, obscure; but Aristotle's meaning, on the whole, seems to be this;—"That all those magnitudes which bear the same *ratio* to the same magnitude, though in fact they may form a *multitude*, yet, in a scientific view, they may be regarded as *one;* the mathematical notion of equality being ultimately resolvable into that of *unity* or identity."* It was probably to obviate any difficulty that might have been suggested by diversities of *figure*, that Aristotle has confined his examples to equal straight lines, and to such quadrangles as are not only equal but similar.

Let us now consider the paraphrase of Dr. Gillies. "In mathematical quantities, equality is sameness, because the *definition* of any particular object denoted by the one, is precisely the same with the *definition* of any particular object denoted by the other." Are we to understand by this, that "to all things which are equal the same definition is applicable;" or conversely, that "all things to which the same definition is applicable, are equal?" On the former supposition, it would follow, that the same definition is applicable to a circle, and to a triangle having its base equal to the circumference, and its altitude to the radius. On the latter, that all circles are of the same magnitude; all squares, and all equilateral triangles.—There is, indeed, one sense wherein those geometrical figures which are called by the same name, (all circles, for example,) may be identified in the mind of the logician; inasmuch as any theorem which is proved of one, must equally hold true of all the rest; and the reason of this is assigned, with tolerable correctness, in the last clause of the sentence quoted from Dr. Gillies. But how this reason bears on the question with respect to the convertibility of the terms *equality* and *sameness*, I am at a loss to conjecture.

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* *Τα προς το αυτο τον αυτον εχοντα λογον, ισα αλληλοις εστι.* Euc. Elem. Lib. V. Prop. ix.

Note (G.) p. 197.

In an Essay on Quantity, (by Dr. Reid) published in the Transactions of the Royal Society of London, for the year 1748, mathematics is very correctly defined to be "the doctrine of measure."—"The object of this science (the author observes) is commonly said to be *quantity;* in which case, quantity ought to be defined, *what may be measured.* Those who have defined quantity to be whatever is capable of more or less, have given too wide a notion of it, which has led some persons to apply mathematical reasoning to subjects that do not admit of it."* The appropriate objects of this science are therefore such things alone as admit not only of being increased and diminished, but of being multiplied and divided. In other words, the common quality which characterizes all of them is their *mensurability.*

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* In this remark, Dr. Reid, as appears from the title of his paper, had an eye to the abuse of mathematical language by Dr. Hutcheson, who had recently carried it so far as to exhibit algebraical formulas for ascertaining the moral merit or demerit of particular actions. (See his Inquiry into the Original of our Ideas of Beauty and Virtue.)

In the same Essay, Dr. Reid has illustrated, with much ingenuity, a distinction (hinted at by Aristotle*) of quantity into proper and improper. "I call that (says he) proper quantity, which is measured by its own kind; or which, of its own nature, is capable of being doubled or trebled, without taking in any quantity of a different kind as a measure of it. Thus a line is measured by known lines, as inches, feet, or miles; and the length of a foot being known, there can be no question about the length of two feet, or of any part or multiple of a foot. This known length, by being multiplied or divided, is sufficient to give us a distinct idea of any length whatsoever.

"Improper quantity is that which cannot be measured by its own kind, but to which we assign a measure in some proper quantity that is related to it. Thus velocity of motion, when we consider it by itself, cannot be measured. We may perceive one body to move faster, another slower, but we can perceive no proportion or ratio between their velocities, without taking in some quantity of another kind to measure them by. Having therefore observed, that by a greater velocity, a greater space is passed over in the same time, by a less velocity a less space, and by an equal velocity an equal space; we hence learn to measure velocity by the space passed over in a given time, and to reckon it to be in exact proportion to that; and having once assigned this measure to it, we can then, and not till then, conceive one velocity exactly double, or triple, or in any proportion to another. We can then introduce it into mathematical reasoning, without danger of error or confusion; and may use it as a measure of other improper quantities.

"All the proper quantities we know may I think be reduced to these four: extension, duration, number, and proportion.

"Velocity, the quantity of motion, density, elasticity, the vis insita and impressa, the various kinds of centripetal forces, and the different orders of fluxions, are all improper quantities; which therefore ought not to be admitted into mathematical reasoning, without having a measure of them assigned.

"The measure of an improper quantity ought always to be included in the definition of it; for it is the giving it a measure that makes it a proper subject of mathematical reasoning. If all mathematicians had considered this, as carefully as Sir Isaac Newton has done, some trouble had been saved both to themselves and their readers. That great man, whose clear and comprehensive understanding appears even in his definitions, having frequent occasion to treat of such improper quantities, never fails to define them, so as to give a measure of them, either in proper quantities, or such as had a known measure. See the definitions prefixed to his Principia."

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* Κυριως δε Ποσα ταυτα λεγεται μονα, τα δε αλλα παντα κατα συμβεβηκος· εις ταυτα γαρ αποβλεποντες, ἢ τα αλλα Ποσα λεγομεν. (Arist. Categ. cap. vi. 17.)

With these important remarks I entirely agree, excepting only the enumeration here given of the different kinds of proper quantity, which is liable to obvious and insurmountable objections. It appears to me that, according to Reid's own definition, extension is the only proper quantity within the circle of our knowledge. Duration is manifestly not measured by duration, in the same manner as a line is measured by a line; but by some regulated motion, as that of the hand of a clock, or of the shadow on a sun-dial. In this respect it is precisely on the same footing with velocities and forces, all of them being measured, in the last result, by extension. As to number and proportion, it might be easily shown, that neither of them fall under the definition of quantity, in any sense of that word. In proof of this assertion (which may, at first sight, seem somewhat paradoxical) I have only to refer to the mathematical lectures of Dr. Barrow, and to some very judicious observations introduced by Dr. Clarke in his controversy with Leibnitz. It is remarkable, that at the period when this essay was written, Dr. Reid should have been unacquainted with the speculations of these illustrious men on the same subject; but this detracts little from the merits of his memoir, which rest chiefly on the strictures it contains on the controversy between the Newtonians and Leibnitzians concerning the measure of forces.

Note (H.) p. 198.

The following view of the relation between the theorems of pure geometry and their practical applications, strikes me as singularly happy and luminous; more especially the ingenious illustration borrowed from the science of geometry itself.

" Les vérités que la géométrie démontre sur l'étendue, sont des vérités purement hypothétiques. Ces vérités cependant n'en

sont pas moins utiles, eu égard aux conséquences pratiques qui en résultent. Il est aisé de le faire sentir par une comparaison tirée de la géométrie même. On connoit dans cette science des lignes courbes qui doivent s'approcher continuellement d'une ligne droite, sans la rencontrer jamais, et qui néanmoins, étant tracées sur le papier, se confondent sensiblement avec cette ligne droite au bout d'un assez petit espace. Il en est de même des propositions de géométrie; elles sont *la limite intellectuelle des vérités physiques*, le terme dont celles-ci peuvent approcher aussi prés qu'on le desire, sans jamais y arriver exactement. Mais si les théorêmes mathématiques n'ont pas rigoureusement lieu dans la nature, ils servent du moins à résoudre, avec une précision suffisante pour la pratique, les différentes questions qu'on peut se proposer sur l'étendue. Dans l'univers il n'y a point de cercle parfait; mais plus un cercle approchera de l'etre, plus il approchera des propriétés rigoureuses du cercle parfait que la géométrie démontre; et il peut en approcher à un degré suffisant pour notre usage. Il en est de même des autres figures dont la géométrie détaille les propriétés. Pour démontrer en toute rigueur, les vérités relatives à la figure des corps, on est obligé de supposer dans cette figure une perfection arbitraire qui n'y sauroit être. En effet, si le cercle, par exemple, n'est pas supposé rigoureux, il faudra autant de théorêmes différens sur le cercle qu'on imaginera de figures différentes plus ou moins approchantes du cercle parfait; et ces figures elles-mêmes pourront encore être absolument hypothétiques, et n'avoir point de modele existant dans la nature. Les lignes qu'on considere dans la géométrie usuelle, ne sont ni parfaitement droites, ni parfaitement courbes; les surfaces ne sont ni parfaitement planes, ni parfaitement curvilignes; mais il est nécessaire de les supposer telles, pour arriver à des vérités fixes et déterminées, dont ou puisse faire ensuite l'application plus ou moins exacte aux lignes et aux surfaces physiques."—D'Alembert, Elémens de Philosophie, Article *Géométrie.*

Note (I.) p. 215.

From some expressions in this quotation, it would seem that the writer considered it as now established by mathematical demonstration, not only that a provision is made for maintaining

the order and the stability of the solar system; but that, after certain periods, all the changes arising from the mutual actions of the planets, begin again to be repeated over in an invariable and eternal *round*;—or rather, that all this is the result of the *necessary* properties of matter and of motion. The truth is, that this assumption is quite unfounded, in point of fact; and that the astronomical discovery in question affords not the slightest analogical presumption in favour of a *moral cycle*; even on the supposition, that the actions of the human race, and the motions of the globe which they inhabit, were both equally subjected to the laws of mechanism.

I shall avail myself of this opportunity to remark further, that notwithstanding the lustre thrown by the result of La Grange's investigations on the metaphysical reasoning of Leibnitz against the *manus emendatrix* of Newton,—this reasoning, when we consider the vagueness of the abstract principles on which it rests, can be regarded in no other light than as a fortunate conjecture on a subject where he had neither experience nor analogy for a guide. The following argument is not ill-stated by Voltaire; and, in my opinion, is more plausible than any thing alleged *a priori*, on the other side of the question, by Leibnitz. "Il est trop clair par l'expérience que Dieu a fait des machines pour être détruites. Nous sommes l'ouvrage de sa sagesse; et nous périssons. Pourquoi n'en seroit-il pas de même du monde? Leibnitz veut que ce monde soit parfait; mais si Dieu ne l'a formé que pour durer un certain tems, sa perfection consiste alors à ne durer que jusq' à l'instant fixé pour sa dissolution." Voltaire's Account of Newton's Philosophy.

For some excellent observations on these opposite conjectures of Leibnitz and of Newton, see Edinburgh Review, Vol. XIV. pp. 80, 81.

The quotation which gave occasion to the foregoing strictures induces me to add, before concluding this note, that when we speak of La Grange's *Demonstration* of the Stability of the Solar System, it is by no means to be understood that he has proved, by mathematical reasoning, that this system never *will*, nor ever *can* come to an end. The amount of his truly sublime discovery is, that the system does *not*, as Newton imagined, contain within itself, like the workmanship of mortal hands, the elements of its own decay; and that, therefore, its final dissolution is to be looked for, not from the operation of physical causes subjected to the calculations of astronomers, but from the will of that Almighty Being, by whose *fiat* it was at first called into existence. That this stability is a *necessary* consequence of the general laws by which we find the system to be governed, may, indeed, be assumed as a demonstrated proposition; but it must always be remembered, that *this necessity is only hypothetical or conditional*, being itself dependent on the continuance of laws, which may at pleasure be altered or suspended.

The whole of the argument in the text, on the permanence or stability of the order of nature, is manifestly to be understood with similar restrictions. It relates, not to necessary but to probable truths; not to conclusions syllogistically deduced from abstract principles, but to *future contingencies*, which we are determined to *expect* by a fundamental Law of Belief, adapted to the present scene of our speculations and actions.

Note (K.) p. 221.

"The power of designating an individual object by an appropriate articulation, is a necessary step in the formation of language, but very far removed indeed from its consummation. Without the use of general signs, the speech of man would differ little from that of brutes: and the transition to the general term from the name of the individual is a difficulty which remains still to be surmounted. Condillac, indeed, proposes to show, how this transition may be made in the natural course of things. "Un enfant appelle du nom *d'arbre*, le premier arbre que nous lui montrons. Un second arbre qu'il voit ensuite lui rappelle la même idée; il lui donne le même nom; de même à un troisième, à un quatrième, et voilà le mot *d'arbre*, donné d'abord à un individu, qui devient pour lui un nom de classe ou de genre, une idée abstraite qui comprend tous les arbres en general." In like manner, Mr. Adam Smith, in his *Dissertation on the Origin of Languages*, and Mr. Dugald Stewart, in his *Elements of the Philosophy of the Human Mind*, endeavour to explain this process, by representing those words which were originally used as the proper names of individuals, to be successively transferred to other individuals, until at length each of them became insensibly the common name of a multitude. This, however, is more ingenious than solid. The name given to an individual, being intended exclusively to designate that individual, it is a direct subversion of its very nature and design, to apply it to any other individual, known to be different from the former. The child, it is true, may give the name of *father* to an individual like to the person it has been taught to call by that name: but this is from mistake, not from design; from a confusion of the two as the same person, and not from a perception of resemblance between them whilst known to be different. In truth, they whose thoughts are occupied solely about individual objects, must be the more careful to distinguish them from each other; and accordingly, the child will most peremptorily retract the appellation of *father*, so soon as the distinctness is observed.* The object with those whose terms or signs refer only to individuals, must naturally be to take care, that every such term or sign shall be applied to its appropriate individual, and to none else. Resemblance can produce no other effect, than to enforce a greater caution in the application of the particular names, and therefore has no natural tendency to lead the mind to the use of general terms." (Discourses and Dissertations on the Scriptural Doctrines of Atonement and Sacrifice. By William Magee, D. D. Senior Fellow of Trinity College, and Professor of Mathematics in the University of Dublin. Vol. II. pp. 63, 64. 3d Edit.)

The observations in pp. 221, 222, &c. of this volume, (to which I must request the attention of my readers before they proceed to the following remarks,) appear to me to weaken considerably the force of this reasoning, as far as it applies to the *substance* of the theory in question. With respect to Mr. Smith's illustration, drawn from the *accident* of a child's calling a stranger by the name of *father*, I readily acknowledge that it was unluckily chosen; and I perfectly assent to the strictures bestowed on it by Dr. Magee. In consequence of the habitual intercourse which this domestic relation naturally keeps up between the parties, the *mistake* of the child (as Dr. Magee very properly calls it) must, of course, be immediately corrected; and therefore, the example is of no use whatever in confirming the conclusion it is brought to support. It is to be regretted that, upon this occasion, Mr. Smith should not only have appealed to a period of infancy, when the notions of similarity and of identity cannot fail to be sometimes one and the same; but should have assumed, as a general fact, an accidental occurrence, which, if it ever has happened, may be justly regarded as an exception to the usual history of the species. While yet on the breast, a child is able to distinguish, with the utmost quickness and accuracy, between the face of an acquaintance and that of a stranger; and, when it is so far advanced as to begin to utter articulate sounds, any tendency to transfer or to generalize the words *mother* or *nurse* seems scarcely conceivable. We are apt to suppose that the first attempts towards speech are coeval with the study of language; whereas the fact manifestly is, that these attempts are only the consequences of the progress previously and silently made in the interpretation of words. Long before this time, many of the logical difficulties which appear so puzzling to the speculative grammarian, have been completely surmounted.*

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* These remarks have a particular reference to the following sentence in Mr. Smith's Dissertation: "A child that is just learning to speak calls every person who comes to the house its *papa* or its *mama;* and thus bestows upon the whole species those names which it had been taught to apply to two individuals."

But although this particular example has been ill chosen, it does not therefore follow that the author's theory is altogether unfounded. Whoever has paid any attention to the phenomena of the infant mind, must be satisfied of its strong bias, in the first developement of the intellectual powers, to apply to similar objects a common name, without ever thinking of confounding them together. Nor does this hold merely with respect to similar *objects*: it holds also (and at a surprisingly early period life) with respect to similar *relations*. A child who has been accustomed to the constant attentions and caresses of its mother, when it sees another child in the arms of its nurse, will naturally and infallibly call the nurse the child's mother. In this instance, as in numberless others, its error arises from generalizing too hastily; the distinction between the meanings of the two relative words Mother and Nurse being too complex to be comprehended, till the power of observation begins to be exercised with some degree of attention and accuracy. This disposition, however, to transfer names from one thing to another, the diversity of which is obvious even to sense, certainly affords no inconsiderable an argument in favour of the opinion disputed by Dr. Magee.

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* The general fact with respect to children, assumed by Mr. Smith in the foregoing note, is stated still more strongly by Aristotle. Both of these philosophers have, I suspect, trusted more, in this instance, to theory than to observation. *Και τα παιδια το μεν πρωτον προσαγορευει παντας τους ανδρας, πατερας· ϗ μητερας, τας γυναικας· ὑστερον δε διοριζει τουτων ἑκατερον.* "Ac pueri quoque primùm omnes viros appellant patres, et omnes mulieres, matres: postea vero discernunt horum utrumque." (Arist. Nat. Ausc. Lib. I. Cap. i.)

This passage (which I do not recollect to have seen quoted by any former writer) does honour to Aristotle's acuteness. The *fact*, indeed, asserted in it, is more than questionable; but, admitting the fact to be true, it must be owned that Aristotle has viewed it in a juster light than Mr. Smith;—not as an instance of any disposition to generalize proper names, but merely of imperfect and undistinguishing perception.

It is indeed, wonderful, how readily children transfer or generalize the name of the *maternal relation* (*that* which of all others must necessarily impress their minds most strongly) not only in the case of their own species, but of the lower animals; applying with little or no aid from instruction, the word *mother* to the hen, the sheep, or the cow, whom they see employed in nurturing and cherishing their young.

To myself, I own, it appears, that the theory of Condillac and Smith on this point, is confirmed by every thing I have been able to observe of children. Even generic terms will be found, on examination, if I be not much deceived, to be originally understood by them merely as *proper names;* insomuch that the notions annexed by an infant to the words denoting the different articles of its nursery-furniture, or the little toys collected for its amusement, are, in its conceptions, as individually and exclusively appropriated, as the names of its father, mother, or nurse. If this observation be well-founded, the same gradual conversion of proper names into appellatives, which Mr. Smith supposes to have taken place in the formation of a language, is exemplified in the history of every infant while learning to interpret its mother tongue. The case is nearly the same with the peasant, who has never seen but one town, one lake, or one river. All of these appellatives are to his ear, precisely equivalent to so many proper names.

> " Quo te, Mœri, pedes? An, quo via ducit, in Urbem?"

That resemblance is one of our most powerful associating principles will not be disputed; and that, even in the maturity of our reason, we have a natural disposition to generalize the meaning of signs, in consequence of apprehended similarities, both of *things* and of *relations*, is equally certain. Why then should it be apprehended, that there is any peculiar mystery connected with this step in the commencement of the progress, when it seems to admit of an explanation so satisfactory, from a law of the human mind, exemplified daily in facts falling within the circle of our own experience?

Note (L.) p. 247.

"Aristotle's rules are illustrated, or rather, in my opinion, *purposely darkened*, by putting letters of the alphabet for the several terms." (Reid's Analysis of Aristotle's Logic.)

On this remark the following criticism has been made by Dr. Gillies.

"In the first Analytics, Aristotle shows, what is that arrangement of terms in each proposition, and that arrangement of propositions in each syllogism, which constitutes a necessary connexion between the premises and the conclusion. When this connexion takes place, the syllogism is perfect in point of form; and when the form is perfect, the conclusion necessarily follows from the premises, whatever be the signification of the terms of which they are composed. These terms, therefore, he commonly expresses by the letters of the alphabet, for the purpose of showing that our assent to the conclusion results, not from comparing the things signified, but merely from considering the relation which the signs (whether words or letters) bear to each other. Those, therefore, totally misconceive the meaning of Aristotle's logic, who think that by employing letters instead of words, he has *darkened* the subject; since the more abstract and general his signs are, they must be the better adapted to show, that the inference results from considering them alone, without at all regarding the things which they signify."*

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* Analysis of Aristotle's Speculative Works, &c. by Dr. Gillies, Vol. I. p. 89. 2d Edit.

From a note at the foot of the page it appears, that the remarks just quoted from Reid gave occasion to the above strictures.

With the doctrine stated in the beginning of this extract I entirely agree. It coincides indeed remarkably with a passage in the former volume of this work, where I have shown, at some length, that our assent to the conclusion of a legitimate syllogism results not from comparing the things signified, but merely from considering the relations of the signs; and consequently, that letters of the alphabet might be substituted instead of verbal terms, without impairing the force of the argument. The observation appears to myself of considerable importance, when connected with the fundamental question *there* discussed, concerning the use of language as an instrument of thought; but, I own, I am at a loss to conceive how it should have been supposed to bear on the present subject. The only point at issue between Dr. Gillies and Dr. Reid is, whether the use of letters instead of words be, or be not, a useful expedient for facilitating the study of logic; and upon this, I apprehend, there can scarcely exist a diversity of opinion. No instance, I will venture to affirm, ever occurred of any hesitation in the mind of the merest novice about the conclusiveness of a legitimate syllogism, when illustrated by an example; but how difficult to explain to a person altogether unaccustomed to scholastic abstractions, the import and cogency of those symbolical demonstrations by which Aristotle has attempted to fortify the syllogistic theory!

The partiality of Dr. Gillies for this technical device has probably arisen, in part, from his supposing it to bear a much closer analogy than it does, in fact, to the algebraical art. Another very learned writer has proceeded on the same idea, when he observes, that "it should recommend the study of logic to mathematicians, that, in order to make his *demonstrations* universal Aristotle uses letters as universal characters, standing for all kinds of terms or propositions."* It would be an idle waste of words to show, how very slight this analogy is, and how totally inapplicable to the question before us;—amounting to little more than this, that, in both cases, the alphabet happens to be employed a sa substitute for common language. An analogy, much more in point, may be traced in the practice of designating by letters the different parties in a hypothetical law-suit;—a practice attended with no inconvenience, where these symbols only supply the place of proper names; but which would at once convert the simplest case into an ænigma, if they were to be employed

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* Ancient Metaphysics, Vol. III. p. 51 of the Preface.

(as they are by Aristotle) to denote, not merely individual existences, but the relations of general ideas.

While Dr. Gillies has thus exerted his ingenuity in defending the use made by Aristotle of letters instead of words, it is to be regretted, that he has said nothing about the motives which induced that philosopher, in disproving the illegitimate modes, to content himself with general references to such words as *bonum*, *habitus*, *prudentia*, upon which the student is left to his own judgment, in ringing the various changes necessary for the illustration of the theory. A more effectual contrivance could not easily have been thought of, for perplexing a subject level, in itself, to the meanest capacity. In this respect, it answers the intended purpose still better than his alphabetical *formulæ*.

Note (M.) p. 282.

As instances of what are called by logicians *fallaciæ in dictione*, a modern writer mentions the mistakes which may arise from confounding "*liber* Bacchus, et *liber* a servitute; *liber* codex, et *liber* cortex; *crevi* à cerno, et *crevi* à cresco; *infractus* participium ab *infringo*, et *infractus* compositum ab *in* et *fractus* sensu plane contrario." He mentions also the danger of confounding the literal with the figurative sense of a word as *vulpes* when applied to a quadruped, and to a man noted for cunning.—"Sic siquis arguat (he adds for the sake of illustration) *stellam latrare, quia stella quædam Canis dicitur*, facile respondebitur captioso argumento distinguendo varios sensus ejusdem vocis, indeque ostendendo syllogismi quatuor terminos (si sensum spectes) ubi tres saltem sono comparent."

To exemplify the *fallacia accentus*, the same writer warns us against confounding *hortus* and *ortus; hara* and *ara; malum* adjectivum, and *malum* pro pomo; *cervus* and servus; *concilium* and consilium, &c. &c. The remedy against such fallacies, he gravely tells us, is to distinguish the words thus identified, so as to show that the syllogism consists of more than three terms. "Solvuntur distinguendo ea quæ confunduntur, indeque monstrando pluralitatem terminorum." He acknowledges, however, that fallacies of this sort are not likely to impose on a skilful logician. "Sed crassiores sunt hæ fallaciæ quam ut perito imponant."

I have purposely quoted these remarks, not from a mere schoolman, but from an author justly distinguished both by science and learning, Dr. Wallis of Oxford. They are taken, too, from a treatise written with the express view of adapting the logic commonly taught in our universities to the ordinary business of life; having a formal dedication prefixed to it, to the Royal Society of London, then recently instituted. The subject is the same with that of the third Book of Locke's Essay, relating to the *abuse of words;* and the interval between the two publications was only two years. Yet how immense the space by which they are separated in the history of the Human Mind!

The concluding paragraph, however, of this very puerile chapter on sophisms, bears marks of a mind fitted for higher undertakings. I cannot deny myself the pleasure of transcribing it, and of pointing it out to those who may hereafter speculate upon the theory of wit, as not unworthy of their attention.

" Interim hic monendum duco; quod hæ *fallaciæ*, utcunque justam argumenti vim non habeant, apprime tamen commodæ sunt ad id omne quod *ingeniosum* vulgo dicimus: Ut sunt joci, facetiæ dicteria, scommata, sarcasmi, retorsiones lepidæ, (*wit, raillery, repartee.*) Quippe hoc omne fundari solet in hujusmodi fallaciarum aliquâ. Nonnunquam allusio fit ad verborum sonos; nunc ad ambiguam vocum significationem; nunc ad dubiam syntaxin; nunc proverbialiter dici solita accommodantur sensu proprio, aut vice versa: nunc aliud aperte dicitur, aliud clam insinuatur; saltem oblique insinuatur, quod non erat directo dicendum; nunc verba contrario sensu captantur, et retorquentur; nunc verisimile insinuatur ut verum, saltem ut suspectum; nunc de uno dicitur, quod mutato nomine, de alio intellectum vellent; nunc ironice laudando vituperant; nunc objecta spicula, respondendo declinantur, aut etiam (obliquata) alio diriguntur, forte sic ut auctorem feriant; et fere semper ex ambiguo luditur. Quæ quidem fallaciarum formulæ, si frigidæ sint crassæque, ridentur; si subtiliores arrident: si acutæ, titillant; si aculeatæ, pungunt."

Note (N.) p. 304.

In the first volume of these Elements, I have endavoured to trace the origin of that bias of the imagination, which has led men, in all ages of the world, to consider physical causes and effects as a series of successive events necessarily connected together, like the links of a metallic chain. (See Chap. i. Sect. 2.) So very strong is this bias, that even in the present times some of the most sagacious and cautious of Bacon's followers occasionally show a disposition to relapse into the figurative language of the multitude. "The chain of natural causes (says Dr. Reid) has, not unfitly, been compared to a chain hanging down from heaven: A link that is discovered supports the links below it, but it must itself be supported; and that which supports it must be supported, until we come to the first link, which is supported by the throne of the Almighty." (Essays on the Intellectual Powers, p. 115. 4to Ed.) It is difficult to reconcile the approbation here bestowed on the above similitude, with the excellent and profound remarks on the relation of cause and effect, which occur in other parts of Dr. Reid's works. (See Essays on the Active Powers, p. 44. and pp. 286, 287, 288. 4to Ed.)

Mr. Maclaurin, in the concluding chapter of his Account of Newton's Discoveries, has still more explicitly lent the sanction of his name to this idea of a chain of second causes. "As we cannot but conceive the universe as depending on the first cause and chief mover, whom it would be absurd, not to say impious, to exclude from acting in it; so we have some hints of the manner in which he operates in nature, from the laws which we find established in it. Though he is the source of all efficacy, yet we find that place is left for *second causes*, to act in subordination to him; and mechanism has its share in carrying on the great scheme of nature. The establishing the equality of action and reaction, even in those powers which seem to surpass mechanism, and to be more immediately derived from him, seems to be an indication that those powers, while they derive their efficacy from him, are, however, in a certain degree circumscribed and regulated in their operations by mechanical principles; and that they are not to be considered as *mere immediate volitions of his*, (as they are often represented,) but rather as instruments made by him, to perform the purposes for which he intended them. If, for example, the most noble phenomena in nature be produced by a rare elastic *æthereal medium*, as Sir Isaac Newton conjectured, the whole efficacy of this medium must be resolved into his power and will who is the supreme cause. This, however, does not hinder, but that the same medium may be subject to the like laws as other elastic fluids, in its actions and vibrations; and that, if its nature were better known to us, we might make curious and useful discoveries concerning its effects, from these laws. It is easy to see, that this conjecture no way derogates from the government and influences of the Deity; while it leaves us at liberty to pursue our inquiries concerning the nature and operations of such a medium: *Whereas they who hastily resolve these powers into immediate volitions of the Supreme Cause, without admitting any intermediate instruments, put an end to our inquiries at once; and deprive us of what is probably the most sublime part of philosophy, by representing it as imaginary and fictitious.*"

On the merits of this passage, considered in relation to the evidences of natural religion, I do not mean to offer any remarks here. Some acute strictures upon it in this point of view (but expressed with a most unbecoming and offensive petulance) may be found in the third volume of Baxter's Inquiry into the Human Soul.—It is with the *logical* proposition alone, stated in the concluding sentence, that we are concerned at present; and *this* (although Baxter has passed it over without any animadversion) appears to me highly exceptionable; proceeding on a very inaccurate, or rather totally erroneous conception of the object and aim of physical science. From the sequel of the section to which this note refers, (particularly from pages 307, 308, 309, 310,) I trust it will appear, that supposing all the phenomena of the universe to be produced by *the immediate volitions of the Supreme Cause*, the business of natural philosophers would be precisely the same as upon the hypothesis adopted by Maclaurin; the investigation of the *necessary connexions* linking together physical causes and effects (if any such necessary connexions *do* exist) being confessedly placed beyond the reach of our faculties; and, of consequence, our most successful researches terminating in the discovery of some general law, or in the farther generalization and simplification of laws already known. In this intellectual process there is no more reason to apprehend that any limit is fixed to our inquiries, than that the future progress of geometry should be stopped by the discovery of some one truth comprising the whole science in a single theorem.

Nor do I apprehend that the theory which excludes from the universe *mechanism* (strictly so called) tends, in the smallest degree, to detract from its beauty and grandeur; notwithstanding the popular and much admired argument of Mr. Boyle in support of this idea. "As it more recommends (he observes) the skill of an engineer to contrive an elaborate engine, so as that there need nothing to reach his ends in it, but the contrivance of parts void of understanding; than if it were necessary that, ever and anon, a discreet servant should be employed to concur notably to the operations of this or that part, or to hinder the engine from being out of order: so it more sets off the wisdom of God, in the fabric of the universe, that he can make so vast a machine perform all those many things which he designed it should, by the mere contrivance of brute-matter, managed by certain laws of motion, and upheld by his ordinary and general concourse; than if he employed, from time to time, an intelligent overseer to regulate and control the motion of the parts."[*]—"What may be the opinion of others (says Lord Kames, after quoting the foregoing passage) I cannot say; but to me this argument is perfectly conclusive. Considering this universe as a great machine, the workmanship of an intelligent cause, I cannot avoid thinking it the more complete, the less mending or interposition it requires. The perfection of every piece of workmanship, human and divine, consists in its answering the designed purpose, without bestowing further labour upon it."[†]—To myself, I must confess, Mr. Boyle's argument appears altogether unworthy of its author. The avowed use of a *machine* is to save labour; and therefore, the less frequently the interposition of the artist is necessary, the more completely does the machine accomplish the purpose for which it was made. These ideas surely do not apply to the works of the Almighty. The multiplicity of his operations neither distract his attention, nor exhaust his power; nor can we, without an obvious inconsistency in the very terms of the proposition, suppose him reduced to the necessity of economizing, by means of mechanism, the resources of Omnipotence.[‡]

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[*] Inquiry into the vulgar notion of Nature.

[†] Of the Laws of Motion. Published in the First Volume of the Physical and Literary Essays, read before the Edinburgh Philosophical Society, (1754.)

[‡] A comparison still more absurd than that of Mr. Boyle occurs in the 6th Chapter of Aristotle's book *de Mundo*; where he represents it as unbe-

My object in these observations (I think it proper once more to remind my readers) is not to prejudge the methaphysical question between Maclaurin and Baxter; but merely to establish the two following propositions. 1. That this question is altogether foreign to the principles which form the basis of the inductive logic; these principles neither affirming nor denying the existence of necessary connexions between physical causes and effects, but only asserting, that such connexions, if they do exist, are not objects of human knowledge. 2. That no presumption in favour of their existence is afforded by Mr. Boyle's similitude; the reasoning founded on the supposed analogy between the universe and a machine, being manifestly inapplicable where the *power* as well as the *skill* of the Contriver is admitted to be infinite.—If the remarks offered on these points be well founded, they may serve, at the same time, to show, that the attempt made in the text to illustrate some abstract topics connected with the received Rules of Philosophising was not altogether superfluous.

The metaphysical doctrine maintained by Baxter in opposition to Maclaurin, seems to coincide nearly with Malebranche's Theory of *Occasional Causes*, as well as with the theology of the old Orphic verses quoted in the 7th chapter of Aristotle's Treatise *de Mundo*.—A very striking resemblance is observable between these verses, and the Hymn to Narrayna or the Spirit of God, translated by Sir William Jones from the writings of ancient Hindu Poets.*

Note (O.) p. 321.

Although Dr. Reid was plainly led into this train of thinking by Mr. Hume, the same doctrine, with respect to the relation of *cause* and *effect*, (considered as the object of physical science,)

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coming the *dignity* of the Supreme Being αυτουργειν απαντα,—"to put his own hand to every thing;" a supposition, according to him, "much more unsuitable to the divine majesty, than to conceive a great monarch like Xerxes taking upon himself the actual execution of all his own decrees."

* The same opinion is explicitly avowed by Dr. Clarke, a zealous partizan of the Experimental Philosophy, and one of the ablest logicians that the Newtonian School has hitherto produced. "The course of nature, truly and properly speaking, is nothing but the will of God, *producing certain effects in a continued, regular, constant, and uniform manner*." (Clarke's Works, Vol. II. p. 698. Fol. edit.)

is to be found in many English writers of a far earlier date. Of this assertion I have produced various proofs in my first Volume, from Hobbes, Barrow, Berkeley, and others, to whose speculations on this head Dr. Reid does not seem to have paid any attention. To these quotations I beg leave to add the following, from a book, of which the *third* edition was published in 1737.

" Here it is worth observing, that all the real true knowledge we have of nature is entirely *experimental;* insomuch, that how strange soever the assertion seems, we may lay this down as the first fundamental unerring rule in physics, *that it is not within the compass of human understanding, to assign a purely speculative reason for any one phenomenon in nature;* as why grass is green, or snow is white; why fire burns, or cold congeals. By a *speculative reason*, I mean assigning an immediate *efficient cause a priori*, together with the manner of its operation, for any effect whatsoever purely natural. We find, indeed, by observation and experience, that such and such effects *are* produced; but when we attempt to think of the reason *why*, and the manner *how* the causes work those effects, then we are at a stand, and all our reasoning is precarious, or at best but probable conjecture.

" If any man is surprised at this, let him instance, in some speculative reason he can give for any natural phenomenon; and how plausible soever it appears to him at first, he will, upon weighing it thoroughly, find it at last resolved into nothing more than mere observation and experiment, and will perceive that these expressions generally used to describe the *cause* or manner of the productions of nature, do really signify nothing more than the *effects*." " The Procedure, Extents, and Limits of Human Understanding." Ascribed to Dr. Peter Brown, Bishop of Cork. (London, 1737. 3d Ed.)

For the following very curious extracts, (together with many others of a similar import, both from English and from foreign writers,) I am indebted to a learned correspondent, William Dickson, LL. D. a gentleman well known by his able and meritorious exertions for the abolition of the slave-trade.

" Confidence of *science* is one great reason we miss it: for on this account, presuming we have it everywhere, we seek it not where it is; and therefore fall short of the object of our inquiry. Now, to give further check to *dogmatical* pretensions, and to discover the vanity of assuming ignorance, we'll make a short inquiry, whether there be any such thing as *science* in the sense of its asserters. In their notion, then, *it is the knowledge of things in their true, immediate, necessary causes:* Upon this I'll advance the following observations.

"1. All knowledge of causes is deductive; for we know none by simple intuition, but through the mediation of their effects. So that we cannot conclude any thing to be the cause of another, but from its continual accompanying it; for the causality itself is insensible. But now to argue from a concomitancy to a causality is not infallibly conclusive; yea, in this way lies notorious delusion, &c. &c. &c.

"2. We hold no *demonstration* in the notion of the dogmatist, but where the contrary is impossible:" &c. &c. (*Scepsis Scientifica:* or Confess't Ignorance the Way to Science; in an Essay of the Vanity of Dogmatizing and Confident Opinion; with a Reply to the Exceptions of the learned *Thomas Albius.*[*] By Joseph Glanvill, M. A. London, 1665. Dedicated to the Royal Society.)

"*Causalities* are first found out by *concomitancy*, as I intimated. And our experience of the dependence of one, and independence of the other, shows which is the effect, and which the cause. Definitions cannot discover causalities, for they are formed after the causality is known. So that, in our author's instance, a man cannot know heat to be the atoms of fire, till the concomitancy be known, and the efficiency first presumed. The question is, then, How *heat* is known to be the effect of *fire?* Our author answers by its definition. But how came it to be so defined? The answer must be, by the concomitancy and dependence, for there's nothing else assignable." (SCIR$^{E}_{I}$ tuum nihil est: or the Author's Defence of the Vanity of Dogmatizing against the Exceptions of the learned *Thomas Albius*, in his late SCIRI.) London, 1665.

"Inter causam proprié dictam et effectum oportet esse necessarium nexum; adeo ut positâ actione causæ sequatur necessario effectus. Cum Deus vult aliquid efficere id necessario eveniat oportet, &c. Quia autem ejusmodi nexus non cernitur inter causas creatas et effectus nonnulli causas secundas, seu creatas, sua, vi agere negarunt. Negant corpora a corporibus moveri, quod inter motum corporis, et motum eorum in quæ incidit nullus deprehendatur nexus, adeo ut moto corpore A, necesse sit moveri corpus B, cui colliditur. Iidem quoque negant corpora a spiritibus moveri, quia inter voluntatem spirituum et motum corporum nullam connexionem animadvertunt, &c. Fatendum a nobis hujusmodi connexum nullum cerni, nec sequi ex eo quod, corpore moto, id in quod incidit, movetur; aut ex eo quod, mente volente, corpus agitatur, corpora et mentem esse veras motus causas. Fieri posset, ut occasiones tantum essent, quibus positis, alia causa ageret. Verum uti, ex ejusmodi possibilitate, non collegeris rem ita se habere; ita ne eó quod non adsequeris aliquid, consequens est ut nihil sit; nisi aliunde probaveris tibi esse earum rerum, de quibus agitur, adæquatam ideam, aut rem repugnare, &c.—Possunt inesse corporibus motis, et spiritibus, facultates ignotæ, de quibus judicium nullum, aut negando aut affirmando, ferre possumus. Itaque ex æquo peccant, qui affirmant inesse iis certò facultates efficiendorum quorundam, quæ an ab iis fiant ignorant; et qui negant quidquam inesse corporibus et spiritibus, nisi quod in iis perspicue norunt." Joannis Clerici Opera Philosophica. Amstel. 1698. Ontol. T. I. p. 275.

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[*] Or *White*, a Romish priest, author of a treatise entitled, *Sciri sive Sceptices et Scepticorum a jure Disputationis Exclusio.* (See Biog. Diction.)

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After this cloud of authorities (many of which are from books in very general circulation,) it is surprising that the following sentence should have escaped the pen of Dr. Beattie. "The sea *has* ebbed and flowed twice every day in time past; therefore the sea *will continue* to ebb and flow twice every day in time to come,—is by no means a logical deduction of a conclusion from premises.—THIS REMARK WAS FIRST MADE BY MR. HUME." Essay on Truth, 2d Ed. p. 126.

It is evident, that this remark is only a particular application of the doctrine contained in the above quotations; as well as in the numerous extracts to the same purpose, collected in Note (C.) at the end of the first Volume of this Work. In one of these (from Hobbes) the very same observation is made; and a sort of theory is proposed to explain *how* the mind is thus led to infer the *future* from the *past*;—a theory which, however unsatisfactory for its avowed purpose, is yet sufficient to show, that the author was fully aware, that our expectation of the continuance of the laws of Nature was a fact not to be accounted for from the received principles of the scholastic philosophy.

Note (P.) p. 341.

From the Preface of Pappus Alexandrinus to the Seventh Book of his Mathematical Collection. (See Halley's Version and Restitution of Appollonius Pergæus de Sectione Rationis et Spatii, p. xxviii.)

. . . . "Resolutio est methodus, qui à quæsito quasi jam concesso per ea quæ deinde consequuntur, ad conclusionem aliquam, cujus ope Compositio fiat perducamur. In resolutione enim, quod quæritur ut jam factum supponentes, ex quo antecedente hoc consequatur expendimus; iterumque quodnam fuerit hujus antecedens; atque ita deinceps, usque dum in hunc modum regredientes, in aliquid jam cognitum locoque principii habitum incidamus. Atque hic processus Analysis vocatur, quasi dicas, inversa solutio. E contrario autem in Compositione, cognitum illud, in Resolutione, ultimo loco acquisitum ut jam factum præmittentes; et quæ ibi consequentia erant, hic ut antecedentia naturali ordine disponentes, atque inter se conferentes, tandem ad Constructionem quæsiti pervenimus. Hoc autem vocamus Synthesin. Duplex autem est Analyseos genus, vel enim est veri indagatrix, diciturque Theoretica; vel propositi investigatrix, ac Problematica vocatur. In Theoretico autem genere, quod quæritur, revera itase habere supponentes, ac deinde per ea quæ consequuntur, quasi vera sint (ut sunt ex hypothesi) argumentantes; ad evidentem aliquam conclusionem procedimus. Jam si conclusio illa vera sit, vera quoque est propositio de qua quæritur; ac demonstratio reciproce respondet analysi. Si vero in falsam conclusionem incidamus, falsum quoque erit de quo quæritur.* In Problematico vero genere, quod proponitur ut jam cognitum sisten-tes, per ea quæ exinde consequuntur tanquam vera, perducimur ad conclusionem aliquam: quod si conclusio illa possibilis sit ac ποριστη quod Mathematici *Datum* appellant; possibile quoque erit quod proponitur: et hîc quoque demonstratio reciproce respondebit Analysi. Si

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[*] From the account given in the text of *Theoretical Analysis*, it would seem to follow, that its advantages, as a method of investigation, increase in proportion to the variety of demonstrations of which a theorem admits; and that, in the case of a theorem admitting of one demonstration alone, the two methods would be exactly on a level. The justness of this conclusion will, I believe, be found to correspond with the experience of every person conversant with the processes of the Greek geometry.

vero incidamus in conclusionem impossibilem, erit etiam problema impossibile. Diorismus autem sive determinatio est qua discernitur quibus conditionibus quotque modis problema effici possit. Atque hæc de Resolutione et Compositione dicta sunto."

Note (Q.) p. 374.

The following passage from Buffon, although strongly marked with the author's characteristical spirit of system, is yet, I presume, sufficiently correct in the outline, to justify me for giving it a place in this note, as an illustration of what I have said in the text on the insensible gradations which fix the limits between resemblance and analogy.

"Take the skeleton of a man; incline the bones of the pelvis; shorten those of the thighs, legs, and arms; join the *phalanges* of the fingers and toes; lengthen the jaws by shortening the frontal bones; and lastly, extend the spine of the back. This skeleton would no longer represent that of a man; it would be the skeleton of a horse. For, by lengthening the back-bone and the jaws, the number of the vertebræ, ribs and teeth would be increased; and it is only by the number of these bones, and by the prolongation, contraction, and junction of others, that the skeleton of a horse differs from that of a man. The ribs, which are essential to the figure of animals, are found equally in man, in quadrupeds, in birds, in fishes, and even in the turtle. The foot of the horse, so apparently different from the hand of a man, is composed of similar bones, and, at the extremity of each finger, we have the same small bone resembling the shoe of a horse which bounds the foot of that animal. Raise the skeletons of quadrupeds, from the ape kind to the mouse, upon their hind legs, and compare them with the skeleton of a man; the mind will be instantly struck with the uniformity of structure observed in the formation of the whole group. This uniformity is so constant, and the gradations from one species to another are so imperceptible, that, to discover the marks of their discrimination requires the most minute attention. Even the bones of the tail will make but a slight impression on the observer. The tail is only a prolongation of the os coccygis or rump-bone, which is short in man. The ouran-outang and true apes have no tail, and in the baboon and several other quadrupeds its length is very inconsiderable. Thus, in the creation of animals, the Supreme Being seems to have employed only one great idea, and, at the same time, to have diversified it in every possible manner, that men might have an opportunity of admiring equally the magnificence of the execution and the simplicity of the design." (Smellie's Translation.)

As a proof that the general conclusion in which the foregoing extract terminates, requires some important qualifications and restrictions, it is sufficient to subjoin a few remarks from a later writer, who, with the comprehensive views of Buffon, has combined a far greater degree of caution and correctness in his scientific details.

. . . . . "It has been supposed by certain naturalists, that all beings may be placed in a series or scale, beginning with the most perfect, and terminating in the most simple, or in the one which possesses qualities the least numerous and most common, so that the mind, in passing along the scale from one being to another, shall be nowhere conscious of any chasm or interval, but proceed by gradations almost insensible. In reality, while we confine our attention within certain limits, and especially while we consider the organs separately, and trace them through animals of the same class only, we find them proceed in their degradation, in the most uniform and regular manner, and often perceive a part, or vestige of a part, in animals where it is of no use, and where it seems to have been left by Nature, only that she might not transgress her general law of continuity.

"But, on the one hand, all the organs do not follow the same order in their degradation. *This* organ is at its highest state of perfection in one species of animals; *that* organ is most perfect in a different species, so that, if the species are to be arranged after each particular organ, there must be as many scales or series formed, as there are regulating organs assumed; and in order to construct a general scale of perfection, applicable to all beings, there must be calculation made of the effect resulting from each particular combination of organs,—a calculation which, it is needless to add, is hardly practicable.

On the other hand, these slight shades of difference, these insensible gradations continue to be observed, only while we confine ourselves to the same combinations of leading organs; only while we direct our attention to the same great central springs. Within these boundaries all animals appear to be formed on one common plan, which serves as the ground-work to all the lesser internal modifications; but the instant we pass to animals where the leading combinations are different, the whole of the resemblance ceases at once, and we cannot but be conscious of the abruptness of the transition.

"Whatever separate arrangements may be suitable for the two great classes of animals, with and without vertebræ, it will be impossible to place at the end of the one series, and at the commencement of the other, two animals sufficiently resembling, to form a proper bond of connexion." Introduction to *Cuvier's Leçons d' Anatomie Comparée.*

Note (R.) p. 390.

Of fortunate conjectures or hypotheses concerning the laws of nature, many additional examples might be produced from the scientific history of the 18th century. Franklin's sagacious and confident anticipation of the identity of lightning and of electricity, is one of the most remarkable. The various analogies previously remarked between their respective phenomena, had become, at this period, so striking to philosophers, that the decisive experiment necessary to complete the theory, was carried into execution, in the course of the same month, on both sides of the Atlantic. In the circumstantial details recorded of that made in America, there is something peculiarly interesting. I transcribe them in the words of Dr. Priestley, who assures us that he received them from the best authority.

"After Franklin had published his method of verifying his hypothesis concerning the sameness of electricity with the matter of lightning, he was waiting for the erection of a spire in Philadelphia to carry his views into execution; not imagining that a pointed rod, of a moderate height, could answer the purpose; when it occurred to him that, by means of a common kite, he could have a readier and better access to the regions of thunder, than by any spire whatever. Preparing, therefore, a large silk-handkerchief, and two cross sticks of a proper length on which to extend it, he took the opportunity of the first approaching thunder-storm to take a walk into a field, in which there was a shed convenient for his purpose. But dreading the ridicule which too commonly attends unsuccessful attempts in science, he communicated his intended experiment to nobody but his son, who assisted him in raising the kite.

"The kite being raised, a considerable time elapsed before there was any appearance of its being electrified. One very promising cloud had passed over it without any effect; when at length, just as he was beginning to despair of his contrivance, he observed some loose threads of the hempen string to stand erect, and to avoid one another, just as if they had been suspended on a common conductor. Struck with this promising appearance, he immediately presented his knuckle to the key, and (let the reader judge of the exquisite pleasure he must have felt at that moment) the discovery was complete. He perceived a very evident electric spark. Others succeeded, even before the string was wet, so as to put the matter past all dispute; and when the rain had wet the string, he collected electric fire very copiously. This happened in June 1752, a month after the electricians in France had verified the same theory, but before he heard of any thing they had done."

Priestley's History of Electricity, pp. 180, 181. 4to Ed.

Note (S.) p. 395.

"Natural knowledge may not unaptly be compared to a vegetable, whether plant or tree, which springs from a seed sowed in a soil proper, and adapted by a skilful gardener, for that plant. For as the seed, by small fibrils or roots it shoots out, receives from the soil or earth a nourishment proper and adapted for ascending into the body or stalk, to make it grow in bulk and strength to shoot upwards, and from thence to shoot forth branches, and from them leaves, thereby to draw and receive out of the air a more refined, spirituous, and enlivening juice, which, descending back into the body or stock, increases its stature, bulk, circumference, and strength, by new incirclings, and thereby enables it to send forth more fibrils and greater roots, which afford greater and more plentiful supplies to the stock or trunk, and enables that to exert and shoot forth more branchings and greater numbers of leaves; which, repeating all the effects and operations by continued and constant circulations, at length bring the plant to its full stature and perfection:

"So natural knowlege doth receive its first informations from the supplies afforded by select and proper phenomena of nature conveyed by the senses; these improve the understanding, and enable it to raise some branchings out into conclusions, corollaries, and maxims; these afford a nutritive and strengthening power to the understanding, and enable it to put forth new roots of inquisition, trials, observations, and experiments, and thereby to draw new supplies of information: which further strengthening the understanding, enable it to exert and produce new deductions and new axioms: These circulate and descend downwards, increasing and strengthening the judgment, and thereby enable it to make more striking out of roots of inquiries and experiments, which cause the like effects as before, but more powerfully, and so by consent and continued circulations from phenomena to make deductions, and from deductions to inquire phenomena, it brings the understanding to a complete and perfect comprehension of the matter at first proposed to be considered." (Hooke's Posthumous Works, p. 553.)

Note (T.) p. 397.

" Aliquando observationes et experimenta immediate nobis exhibent principia, quæ quærimus; sed aliquando etiam *hypotheses* in auxilium vocamus, non tamen penitus arbitrarias, sed conformes iis quæ observantur, et quæ supplentes immediatarum observationum defectum, viam investigationi sternunt, tanquam divinantibus; ut si ea, quæ ex ipsis deducuntur, inveniamus re ipsa, eadem retineamus, et progrediamur ad nova consectaria; secus vero, ipsas rejiciamus. Et quidem plerumque hanc esse arbitror methodum omnium aptissimam in physica, quæ sæpissime est velut quædam enucleatio epistolæ arcanis notis conscriptæ, ubi per attentationem, et per errores etiam plurimos paulatim et caute progrediendo, ad veram ejus theoriam devenitur: cujus rei specimen admodum luculentum exhibui in mea dissertatione de lumine, agens de rectilinea luminis propagatione; ac in Stayanæ Philosophiæ Tomo I. agens de generalibus proprietatibus corporum, et de vi inertiæ in primis; Tomo vero II. agens de totius Astronomiæ constitutione." Boscovich de Solis ac Lunæ Defectibus.

In Sprat's History of the Royal Society, a similar idea occurs, illustrated by an image equally fanciful and apposite. " It is not to be questioned, but many inventions of great moment have been brought forth by authors, who began upon suppositions

tions, which afterwards they found to be untrue. And it frequently happens to philosophers, as it did to Columbus; who first believed the *clouds* that hovered about the Continent to be the firm *land:* But this mistake was happy; for, by sailing towards them, he was led to what he sought; so by prosecuting of mistaken causes, with a resolution of not giving over the pursuit, they have been guided to the truth itself."

[The work from which this passage is taken (it may be here remarked, by the way,) affords complete evidence of the share which, in the judgment of the founders of the Royal Society, Bacon had in giving a beginning to experimental pursuits in England. See in particular, Section xvi.]

Note (U.) p. 398.

With respect to the application of the method of *exclusions* to physics, an important logical remark is made by Newton, in one of his letters to Mr. Oldenburgh. Obvious and trivial as it may appear to some, it has been overlooked by various writers of great name; and therefore I think proper to state it in Newton's own words.

"In the meanwhile, give me leave, Sir, to insinuate, that I cannot think it effectual for determining truth, to examine the several ways by which phenomena may be explained, *unless where there can be a perfect enumeration of all those ways.* You know the proper method for inquiring after the properties of things, is to deduce them from experiments. And I told you, that the theory which I propounded (concerning light and colours) was evinced to me, not by inferring, *it is thus, because it is not otherwise;* that is, not by deducing it only from a confutation of contrary suppositions, but by deriving it from experiments concluding positively and directly. The way, therefore, to examine it, is, by considering whether the experiments which I propound, do prove those parts of the theory to which they are applied; or by prosecuting other experiments which the theory may suggest for its examination," &c. &c. Horseley's Edition of Newton's Works, Vol. IV. p. 320.

Note (X.) p. 404.

If we consider the infantine state of our knowledge concerning vision, light, and colours, about a century ago, very great advancements will appear to have been made in this branch of science; and yet a philosopher of the present age has more *desiderata*, can start more difficulties and propose more new subjects of inquiry than even Alhazen or Lord Bacon. The reason is, that whenever a new property of any substance is discovered, it appears to have connexions with other properties, and other things, of which we could have no idea at all before, and which are by this means but imperfectly announced to us. Indeed, every *doubt* implies some degree of *knowledge*; and while nature is a field of such amazing, perhaps boundless extent, it may be expected that the more knowledge we gain, the more doubts and difficulties we shall have; but still, since every advance in knowledge is a real and valuable acquisition to mankind, in consequence of its enabling us to apply the powers of nature to render our situation in life more happy, we have reason to rejoice at every new difficulty that is started, because it informs us that more knowledge, and more advantage are yet unattained, and should serve to quicken our diligence in the pursuit of them. Every *desideratum* is an imperfect *discovery*." Priestley's History of Discoveries relating to Vision, Light, and Colours, p. 773. (Lond. 1772.)

Note (Y.) p. 419.

For the analogies between Galvanism and Electricity, see *Traité Elémentaire de Physique, par M. L'Abbé Haüy*, §. 717.— The passage concludes with the following remark, which may be regarded as an additional proof, that even when analogical conjectures appear to depart the most widely from the evidence of experience, it is from experience that they derive their whole authority over the belief. "Partout le fluide électrique semble se multiplier par la diversité des phenomenes; et il nous avait tellement accoutumés à ses métamorphoses, que la nouveauté même de la forme sous laquelle il s'offrait dans le Galvanisme naissant, semblait être une raison de plus pour le reconnaître."

Note (Z.) p. 431.

In that branch of politics which relates to the theory of Government, one source of error (not unfrequently overlooked by the advocates for experience) arises from the vagueness of the language in which political facts are necessarily stated by the most faithful and correct historians. No better instance of this can be produced than the terms, Monarchy, Aristocracy, and

Democracy, commonly employed to distinguish different forms of Government from each other. These words, in their strict philosophical acceptation, obviously denote not *actual* but *ideal* constitutions, existing only in the imagination of the political theorist; while, in more popular discourse, they are used to discriminate, according to their prevailing bias or spirit, the various mixed establishments exemplified in the history of human affairs. Polybius, accordingly, with his usual discernment, expresses his doubts, under which of the three simple forms the constitution of Rome, at the period when he had an opportunity of studying it, ought to be classed. "When we contemplate (he observes) the power of the Consuls, it seems to be a monarchy; when we attend to the power of the Senate, it seems to be an aristocracy; when we attend to the power of the People, we are ready to pronounce it a democracy."*

It is easy to see how much this scantiness and want of precision in our political vocabulary, must contribute to mislead the judgments of those reasoners who do not analyze very accurately the notions annexed to their words; and, at the same time, what a purchase they afford to the sophistry of such writers as are disposed, in declamations addressed to the multitude, to take an undue advantage of the ambiguities of language.

Another source of error which goes far to invalidate the authority of various political maxims supposed to be founded on

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* This observation of Polybius has been very unjustly criticised by Grotius. "Sed neque Polybii hic utor auctoritate, qui ad mixtum genus reipublicæ refert Romanam rempublicam, quæ illo tempore, si non *actiones ipsas*, sed *jus agendi* respicimus, mere fuit popularis: Nam et senatus auctoritas, quam ad optimatum regimen refert, et consulum quos quasi reges fuisse vult, subdita erat populo. Idem de aliorum politica scribentium sententiis dictum volo, qui magis externam speciem et quotidianam administrationem, quam jus ipsum summi imperii spectare congruens ducunt suo instituto." (De Jure Belli ac Pacis, Lib. I. Cap. 3.) The truth is, that Polybius is not here speaking of the *theory* of the Roman constitution, (about which there could be no diversity of opinion,) but of what common observers are so apt to overlook,—*the actual state of that constitution*, modified as it was by time, and chance, and experience.—Among the numerous commentators on Grotius, I recollect one only (Henry de Cocceii) who has viewed this question in its proper light. "Auctor inter eos, qui circa formas imperii falluntur etiam Polybium refert, qui rempublicam Romanam suis temporibus mixtam fuisse ait. At bene notandum, Polybium non loqui de mixtura *status* sed *administrationis:* forma enim reipublicæ erat mere popularis, sed administratio divisa fuit inter consules, senatum, et populum."

experience, is the infinite multiplicity of the seemingly trifling and evanescent causes connected with local manners and habits, which, in their joint result, modify, and in some cases counteract so powerfully, the effects of written laws and of established forms. Of these causes no verbal description can convey an adequate idea; nor is it always possible even for the most attentive and sagacious observer, when the facts are before his eyes, to appreciate all their force:—So difficult is it to seize the nicer shades which distinguish the meanings of correspondent terms in different languages; and to enter, at years of maturity, into those delicate and complex associations, which, in the mind of a well-educated native, are identified with the indigenous feelings of national sympathy and taste.

Of the truth of this remark a striking illustration presents itself in the mutual ignorance of the French and English nations (separated from each other by a very narrow channel, and, for centuries past, enjoying so many opportunities of the most familiar intercourse) with respect to the real import of the words and phrases marking the analogous gradations of rank in the two countries. The words *gentilhomme* and *gentleman* are both derived from the same etymological root; yet how imperfect a translation does the one afford of the other! and how impossible to convey by a definition all that is implied in either! Among French writers of no inconsiderable name, we meet with reasonings which plainly show, that they considered the relative rank of the members of our two Houses of Parliament, as something similar to what is expressed in their own language by the words *noble* and *roturier*;—while others, puzzled with the inexplicable phenomena occasionally arising from the boundless field of ambition opened in this fortunate island to every species of industry and of enterprize, have been led to conclude, that birth has, among us, no other value than what it derives from the privileges secured by the constitution to our hereditary legislators. Few perhaps but the natives of Great Britain are fully aware, how very remote from the truth are both these suppositions.

I transcribe the following passage from an article in the French *Encyclopedie*, written by an author of some distinction both for talents and learning; and which, it is not impossible, may be quoted at some future period in the history of the world, as an authentic document with respect to the state of English society in the 18th century. The writer had certainly much better access to information than was enjoyed by those to whom we are indebted for our experimental knowledge of the ancient systems of policy.

"En Angleterre, la loi des successions attribue aux aînés dans les familles nobles les biens immeubles, à l'exclusion des cadets qui n'y ont aucune part. Ces cadets sans bien cherchent à réparer leurs pertes dans l'exercice du négoce, et c'est pour eux un moyen presque sur de s'enrichir. Devenus riches, ils quittent la profession, ou même sans la quitter, leurs enfans rentrent dans tous les droits de la noblesse de leur famille; leurs aînés prennent le titre de *milord* si leur naissance et la possession d'une terre pairie le leur permettent.—Il faut néanmoins remarquer, que quelque fiére que soit la noblesse Angloise, lorsque les nobles entrent en apprentissage, qui selon les réglemens doit être de sept ans entiers, jamais ils ne se couvrent devant leurs maitres, leur parlant et travaillant tête nue, quoique souvent le maitre soit roturier et de race marchande, et que les apprentiss soient de la première noblesse." Encyclop. Method. Commerce, Tom. 3. Article *Noblesse*.

Note (AA.) p. 439.

"Metaphysicæ pars secunda est finalium causarum inquisitio, quam non ut prætermissam, sed ut male collocatam notamus. Solent enim inquiri inter physica non inter metaphysica. Quanquam si ordinis hoc solum vitium esset, non mihi fuerit tanti. Ordo enim ad illustrationem pertinet, neque est ex substantia scientiarum. At hæc ordinis inversio defectum insignem peperit, et maximam philosophiæ induxit calamitatem. Tractatio enim causarum finalium in physicis, inquisitionem causarum physicarum expulit et dejecit, effecitque ut homines in istiusmodi speciosis et umbratilibus causis acquiescerent, nec inquisitionem causarum realium, et vere physicarum, strenue urgerent, ingenti scientiarum detrimento. Etenim reperio hoc factum esse non solum a Platone, qui in hoc littore semper anchoram figit, verum etiam ab Aristotele, Galeno, et aliis, qui sæpissime etiam ad illa vada impingunt. Etenim qui causas adduxerit hujusmodi, *palpebras cum pilis pro sepi et vallo esse, ad munimentum oculorum*: aut *corium in animalibus firmitudinem esse ad propellendos calores et frigora*: Aut *ossa pro columnis et trabibus a natura induci, quibus fabrica corporis innitatur*: Aut *folia arborum emitti, quo fructus minus patiantur à sole et vento*: Aut *nubes in sublimi fieri, ut terram imbribus irrigent*: Aut *terram densari* *et solidari, ut statio et mansio sit animalium:* et alia similia: Is in metaphysicis non male ista allegarit; in physicis autem nequaquam. Imo, quod cœpimus dicere, hujusmodi sermonum discursus (instar remorarum, uti fingunt, navibus adhærentium) scientiarum quasi velificationem et progressum retardarunt, ne cursum suum tenerent, et ulterius progrederentur: et jampridem effecerunt, ut physicarum causarum inquisitio neglecta deficeret, ac silentio præteriretur. Quapropter philosophia naturalis Democriti, et aliorum, qui Deum et mentem à fabrica rerum amoverunt; et structuram universi infinitis naturæ prælusionibus et tentamentis (quas uno nomine *fatum* aut *fortunam* vocabant) attribuerunt; et rerum particularium causas, materiæ necessitati, sine intermixtione causarum finalium, assignarunt; nobis videtur, quatenus ad causas physicas, multo solidior fuisse, et altius in Naturam penetrasse, quam illa Aristotelis, et Platonis: Hanc unicam ob causam, quod illi in causis finalibus nunquam operam triverunt; hi autem eas perpetuo inculcarunt. Atque magis in hac parte accusandus Aristoteles quam Plato; quandoquidem fontem causarum finalium, Deum scilicet, omiserit, et naturam pro Deo substituerit, causasque ipsas finales, potius ut logicæ amator quam theologiæ, amplexus sit. Neque hæc eo dicimus, quod causæ illæ finales veræ non sint, et inquisitione admodum dignæ in speculationibus metaphysicæ, sed quia dum in physicarum causarum possessiones excurrent et irruunt, misere eam provinciam depopulantur et vastant." De Augm. Scient. Lib. III. Cap. 4.

Note (BB.) p. 450.

Among the earliest opponents of Des Cartes's doctrine concerning *Final Causes*, was Gassendi; a circumstance which I remark with peculiar pleasure, as he has been so unjustly represented by Cudworth and others, as a partisan, not only of the physical, but of the atheistical opinions of the Epicurean school. For this charge I do not see that they had the slightest pretence to urge, but that, in common with Bacon, he justly considered the physical theories of Epicurus and Democritus as more analogous to the experimental inquiries of the moderns, than the logical subtilties of Aristotle and of the schoolmen. The following passage is transcribed in Gassendi's own words, from his Objections to the Meditations of Des Cartes.

" Quod autem à *physica consideratione rejicis usum causarum finalium*, aliâ fortassis occasione potuisses recte facere: at de

Deo cùm agitur verendum profectò, ne præcipuum argumentum rejicias, quo divina sapientia, providentia, potentia, atque adeò existentia, lumine naturæ stabiliri potest. Quippe ut mundum universum, ut cœlum et alias ejus et præcipuas partes prætercam undenam, aut quomodo meliùs argumentare valeas, quàm ex usu partium in plantis, in animalibus, in hominibus, in te ipso (aut corpore tuo) qui similitudinem Dei geris? Videmus profectò magnos quosque viros ex speculatione anatomica corporis humani non assurgere modò ad Dei notitiam, sed hymnum quoque ipsi canere, quòd omnes partes ita conformaverit, collocaveritque ad usus, ut sit omnino propter solertiam atque providentiam incomparabilem commendandus." Objectiones Quintæ in Meditationem IV. *De Vero et Falso.*

I do not know if it has been hitherto remarked, that Gassendi is one of the first modern writers, by whom the following maxim, so often repeated by later physiologists, was distinctly stated; "*Licet ex conformatione partium corporis humani, conjecturas desumere ad functiones mere naturales.*" It was from a precipitate application of this maxim, that he was led to conclude, that man was originally destined to feed on vegetables alone; a proposition which gave occasion to several memoirs by Dr. Wallis and Dr. Tyson, in the Philosophical Transactions of the Royal Society of London.

Note (CC.) p. 483.

The theories of Hume, of Paley, and of Godwin, how differently soever they may have figured in the imaginations of their authors, are all equally liable to the fundamental objections stated in the text. The same objections are applicable to the generous and captivating, but not always unexceptionable morality inculcated in the writings of Dr. Hutcheson.—The system, indeed, of this last philosopher, may be justly regarded as the parent stock on which the speculations of the others have been successively grafted.

Mr. Hume entered on his Inquiries concerning Morals, at a period when Dr. Hutcheson's literary name was unrivalled in Scotland. The abstract principles on which his doctrines are founded, differ widely from those of his predecessor, and are unfolded with far greater ingenuity, precision, and elegance. In various instances, however, he treads very closely in Dr.

Hutcheson's footsteps; and, in the final result of his reasonings, he coincides with him exactly. According to both writers, a regard to general expediency affords the only universal canon for the regulation of our conduct.

It is a curious circumstance in the History of Ethics, that the same practical rule of life, to which Dr. Hutcheson was so naturally and directly led by his cardinal virtue of disinterested benevolence, has been inferred by Dr. Paley from a theory which resolves moral obligation entirely into prudential calculations of individual advantage. For the very circuitous, and (in my opinion) very illogical argument, whereby he has attempted to connect his conclusion with his premises, I must refer to his work.*

The *political justice* of Mr. Godwin is but a new name for the principle of general expediency or utility. "The term *justice* (he observes) may be assumed as a general appellation for all moral duty. That this appellation (he continues) is sufficiently expressive of the subject, will appear, if we consider for a moment, mercy, gratitude, temperance, or any of those duties which, in looser speaking, are contradistinguished from justice. Why should I pardon this criminal, remunerate this favour, abstain from this indulgence? If it partake of the nature of morality, it must be either right or wrong, just or unjust. It must tend to the benefit of the individual, either without entrenching upon, or with actual advantage to the mass of individuals. Either way, it benefits the whole, because individuals are parts of the whole. Therefore, to do it is just, and to forbear it is unjust. If justice have any meaning, it is just that I should contribute every thing in my power to the benefit of the whole." (Polit. Justice, Vol. I. pp. 80, 81.)

It is manifest, that, in the foregoing extract, the duty of *justice* is supposed to coincide exactly as a rule of conduct with the affection of *benevolence;* whereas, according to the common use of words, justice means that particular branch of virtue which leads us to respect the *rights* of others; a branch of virtue remarkably distinguished from all others by this, that the observance of it may be extorted by force; the violation of it exposing the offender to resentment, to indignation, and to punishment. In Mr. Godwin's language, the word *justice* must either be understood to be synonymous with general *benevolence*, or—assuming the existence of such an affection—to express the *moral fitness* of yielding, upon all occasions, to its suggestions. "It is *just* (says Mr. Godwin) that I should contribute every thing in my power to the benefit of the whole.—My benefactor ought to be esteemed, not because he bestowed a benefit upon me, but because he bestowed it upon a human being. His desert will be in exact proportion to the degree in which the human being was worthy of the distinction conferred. Thus, every view of the subject brings us back to the consideration of my neighbour's moral worth, and his importance to the general weal, as the only standard to determine the treatment to which he is entitled. Gratitude, therefore, a principle which has so often been the theme of the moralist and the poet, is no part either of *justice* or virtue." (Ibid. p. 84.) The words *just* and *justice* can, in these sentences, mean nothing distinct from morally *fit* or *reasonable*; so that the import of the doctrine amounts merely to the following proposition, That it is reasonable or right, that the private benevolent affections should, upon all occasions, yield to the more comprehensive;—which is precisely the system of Hutcheson disguised under a different and much more exceptionable phraseology.

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* Principles of Moral and Political Philosophy, Book ii. Chap. 1, 2, 3, 4, 5, 6.

The theory of Dr. Paley has been very ably examined by Mr. Gisborne, in a treatise entitled, The Principles of Moral Philosophy investigated, and briefly applied to the Constitution of Civil Society. (London, 1790.) The objections to it there stated appear to me quite unanswerable; and they possess the additional merit of being urged with all the deference so justly due to Dr. Paley's character a[illegible]nts.

This abuse of words is not without its effect in concealing from careless readers the fallaciousness of some of the author's subsequent arguments; for although the idea he professes to convey by the term *justice*, be essentially different from that commonly annexed to it, yet he scruples not to avail himself, for his own purpose, of the received maxims which apply to it in its ordinary acceptation. In discussing, for example, the validity of promises, he reasons thus. "I have promised to do something just and right.—This certainly I ought to perform. Why? Not because I promised, but because *justice* prescribes it. I have promised to bestow a sum of money upon some good and respectable purpose. In the interval between the promise and my fulfilling it, a greater and nobler purpose offers itself, which calls with an imperious voice for my co-operation. Which ought I to prefer? That which best deserves my preference. A promise can make no alteration in the case. I ought to be guided by the intrinsic merit of the objects, and not by any external and foreign consideration. No engagements of mine can change their intrinsic claims. If every shilling of our property, every hour of our time, and every faculty of our mind, have already received their destination from the principles of *immutable justice*, promises have no department left upon which for them to decide. *Justice*, it appears therefore, ought to be done, whether we have promised it or not." (Ibid. p. 151.)

It is quite evident, that, in this passage, the paramount supremacy indisputably belonging to *justice* in its usual and legitimate sense, is ascribed to it when employed as synonymous with *benevolence*; and of consequence, that the tendency of the new system, instead of extending the province of *justice*, properly so called, is to set its authority entirely aside, wherever it interferes with views of utility. In this respect, it exhibits a complete contrast to all the maxims hitherto recognised among moralists. The rules of justice are happily compared by Mr. Smith to the strict and indispensable rules of grammar; those of benevolence to the more loose and general descriptions of what constitutes the sublime and beautiful in writing that we meet with in the works of critics. According to Mr. Godwin, the reverse of this comparison is agreeable to truth; while, at the same time, by a dexterous change in the meaning of terms, he assumes the appearance of combating for the very cause which he labours to betray.

Of the latitude with which the word *justice* had been previously used by many ethical writers, a copious and choice collection of instances may be found in the learned and philosophical notes subjoined by Dr. Parr to his Spital Sermon. (London, 1801.) "By none of the ancient philosophers, however is (as he has well observed,) justice set in *opposition* to any other social duty; nor did they employ the colossal weight of the *term* in crushing the other moral excellencies, which were equally considered as pillars in the temple of virtue." pp. 28, 29, 30, 31.*

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* Having mentioned the name of this eminent person, I eagerly embrace the opportunity of acknowledging the instruction I have received, not only from his various publications, but from the private literary communications with which he has repeatedly favoured me. From one of these (containing animadversions on some passages in my Essay on the Sublime,) I entertain hopes of being permitted to make a few extracts in a future edition of that

Note (DD.) p. 467.

As the main purpose of this section is to combat the logical doctrine which would exclude the investigation of Final Causes from natural philosophy, I have not thought it necessary to take notice of the sceptical objections to the theological inferences commonly deduced from it. The consideration of these properly belongs to some inquiries which I destine for the subject of a separate Essay. On *one* of them alone I shall offer at present a few brief remarks, on account of the peculiar stress laid upon it in Mr. Hume's Posthumous Dialogues.

When two *species* of objects (says Philo) have always been observed to be conjoined together, I can *infer*, by custom, the existence of one wherever I *see* the existence of the other: and this I call an argument from experience. But how this argument can have place, where the objects, as in the present case, are single, individual, without parallel, or specific resemblance, may be difficult to explain. And will any man tell me, with a serious countenance, that an orderly universe must arise from some thought and art, like the human, because we have experience of it? To ascertain this reasoning, it were requisite that we had experience of the origin of worlds; and it is not sufficient surely, that we have seen ships and cities arise from human art and contrivance.—Can you pretend to show any similarity between the fabric of a house, and the generation of the universe? Have you ever seen Nature in any such situation as resembles the first arrangement of the elements? Have worlds ever been formed under your eye; and have you had leisure to observe the whole progress of the phenomenon, from the first appearance of order to its final consummation? If you have, then cite your experience, and deliver your theory."

This celebrated argument appears to me to be little more than an amplification of that which Xenophon puts into the mouth of Aristodemus, in his conversation with Socrates, concerning the existence of the Deity. "I behold (says he) none of those governors of the world whom you speak of; whereas here, I see artists actually employed in the execution of their respective works."—The reply of Socrates, too, is in substance

performance. By his candid and liberal strictures, I have felt myself highly honoured; and should be proud to record, in his own words, the corrections he has suggested of certain critical and philological judgments, which, it is highly probable, I may have too lightly hazarded.

the same with what has been since retorted on Philo, by some of Mr. Hume's opponents. "Neither yet, Aristodemus, seest thou thy soul, which, however, most assuredly governs thy body: although it may well seem, by thy manner of talking, that it is *chance* and not *reason* which governs thee."

Whatever additional plausibility Philo may have lent to the argument of Aristodemus, is derived from the authority of that much abused maxim of the inductive logic, that "all our knowledge is entirely derived from experience." It is curious, that Socrates should have touched with such precision on one of the most important exceptions with which this maxim must be received. Our knowledge of our own existence as sentient and intelligent beings, is (as I formerly endeavoured to show) not an inference from experience, but a fundamental law of human belief. All that experience can teach me of my internal frame, amounts to a knowledge of the various mental operations whereof I am conscious; but what light does experience throw on the origin of my notions of personality and identity? Is it from having observed a constant conjunction between sensations and sentient beings; thoughts and thinking beings; volitions and active beings; that I infer the existence of that individual and permanent *mind*, to which all the phenomena of my consciousness belong? Our conviction that *other men* are, like ourselves, possessed of thought and reason; together with all the judgments we pronounce on their intellectual and moral characters, cannot (as is still more evident) be resolved into an experimental perception of the conjunction of different objects or events. They are inferences of design from its sensible effects, exactly analogous to those which, in the instance of the universe, Philo would reject as illusions of the fancy.*

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* This last consideration is ably stated by Dr. Reid. (See Essays on the Intellectual Powers, pp. 631, 635. 2to Ed.) The result of his argument is, that "according to Philo's reasoning we can have no evidence of mind or design in any of our fellow-men."—At a considerably earlier period, Buffier had fallen into the same train of thinking. Among the judgments which he refers to *common sense*, he assigns the first place to the two following. "1. *Il y a d'autres êtres, et d'autres hommes que moi au monde.* 2. *Il y a dans eux quelque chose qui s'appelle vérité, sagesse prudence,*" &c &c. (Cours de Sciences, p. 566. Paris, 1732.) I have already objected to the application of the phrase *common sense*, to such judgments as these; but this defect in point of expression does not detract from the sagacity of

But leaving for future consideration these abstract topics, let us for a moment attend to the scope and amount of Philo's reasoning.—To those who examine it with attention, it must appear obvious, that, if it proves any thing, it leads to this general conclusion, That it would be perfectly impossible for the Deity if he *did* exist, to exhibit to Man any satisfactory evidence of *design* by the order and perfection of his works. That every thing we see is *consistent* with the supposition of its being produced by an intelligent author, Philo himself has explicitly acknowledged in these remarkable words; "Supposing there were a God, who did not discover himself immediately to our senses; would it be possible for him to give stronger proofs of his existence, than what appear on the whole face of nature? What, indeed, could such a Divine Being do, but copy the present economy of things;—render many of his artifices so plain, that no stupidity could mistake them;—afford glimpses of still greater artifices, which demonstrate his prodigious superiority above our narrow apprehensions;—and conceal altogether a great many from such imperfect creatures?"—The sceptical reasonings of Philo, therefore, do not, like those of the ancient Epicureans, hinge, in the least, on alleged disorders and imperfections in the universe, but entirely on the impossibility, in a case to which experience furnishes nothing parallel or analogous, of rendering intelligence and design manifest to our faculties by their sensible effects.—In thus shifting his ground from that occupied by his predecessors, Philo seems to me to have abandoned the only post from which it was of much importance for his adversaries to dislodge him. The logical subtilties, formerly quoted about experience and belief, (even supposing them to remain unanswered,) are but little calculated to shake the authority of principles, on which we are every moment forced to judge and to act, by the exigencies of life. For this change in the tactics of modern sceptics, we are evidently, in a great measure, if not wholly, indebted to the lustre thrown on the order of nature, by the physical researches of the two last centuries.

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the author in perceiving, that in the conclusions we form concerning the minds and characters of our fellow-creatures, (as well as in the inferences drawn *concerning the invisible things of God from the things which are made*,) there is a perception of the understanding implied, for which neither reasoning nor experience is sufficient to account.

Another concession extorted from Philo by the discoveries of modern science is still more important. I need not point out its coincidence with some remarks in the first part of this section, on the unconscious deference often paid to final causes by those inquirers who reject them in theory;—a coincidence which had totally escaped my recollection when the remarks were written. I quote it here, chiefly as a pleasing and encouraging confirmation of the memorable prediction with which Newton concludes his Optical Queries; that "if *Natural Philosophy*, in all its parts, by pursuing the inductive method, shall at length be perfected, the bounds of *Moral Philosophy* will be enlarged also."

"A purpose, an intention, a design, (says Philo) strikes every where the most careless, the most stupid thinker; and no man can be so hardened in absurd systems, as at all times to reject it. *That Nature does nothing in vain*, is a maxim established in all the schools, merely from the contemplation of the works of Nature, without any religious purpose; and from a firm conviction of its truth, an anatomist, who had observed a new organ or canal, would never be satisfied till he had also discovered its use and intention. One great foundation of the COPERNICAN system is the maxim, *That Nature acts by the simplest methods, and chooses the most proper means to any end;* and astronomers often, without thinking of it, lay this strong foundation of piety and religion. The same thing is observable in other parts of philosophy: And thus all the sciences lead us almost insensibly to acknowledge a first intelligent author; and their authority is often so much the greater, as they do not directly profess that intention."

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* P. 193.

Since this sheet was cast off, I have been informed from the best authority, that the conversation here alluded to, which I had understood to have taken place between Lord Chief Justice Mansfield, and the late Sir Basil Keith, really passed between his Lordship and another very distinguished officer, the late gallant and accomplished Sir Archibald Campbell. I have not, however, thought it worth while, in consequence of a mistake which does not affect the substance of the anecdote, to cancel the leaf;—more especially, as there is at least a possibility that the same advice may have been given on more than one occasion.

THE END